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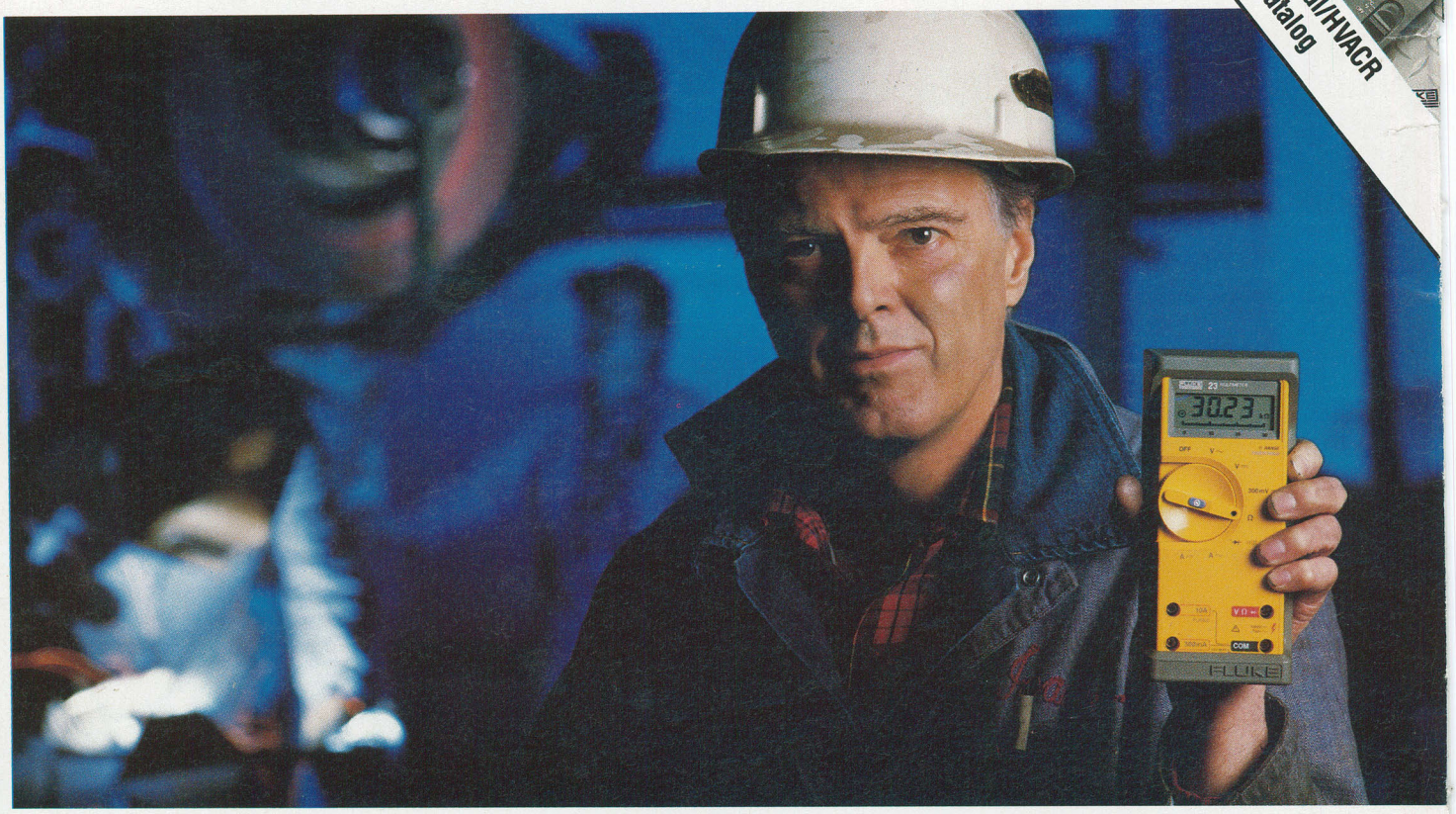

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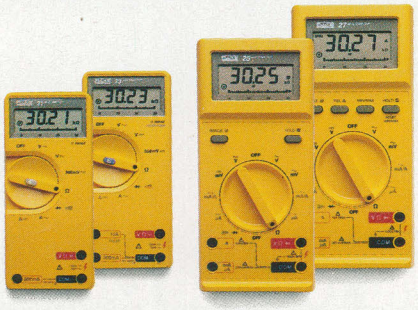

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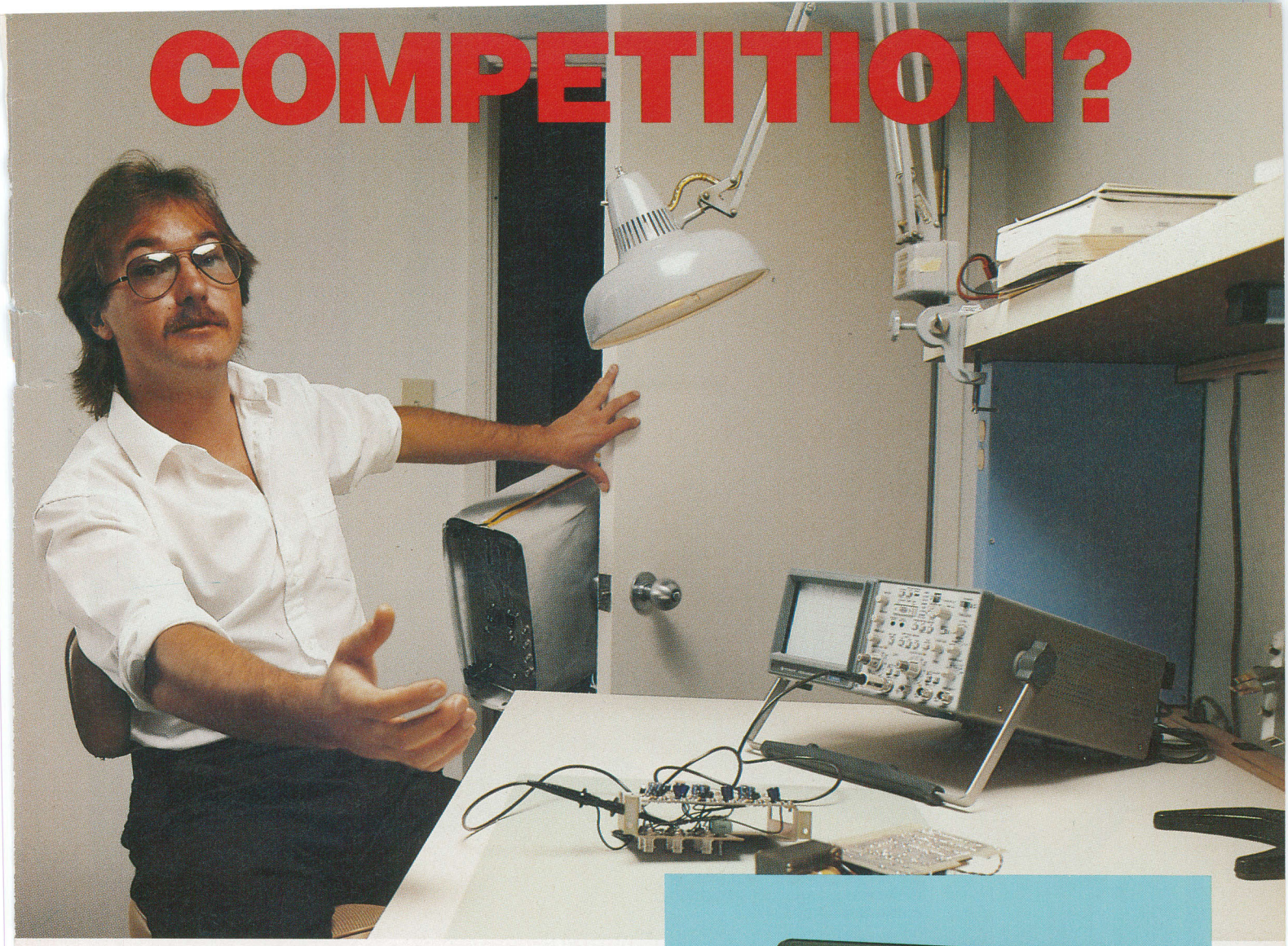

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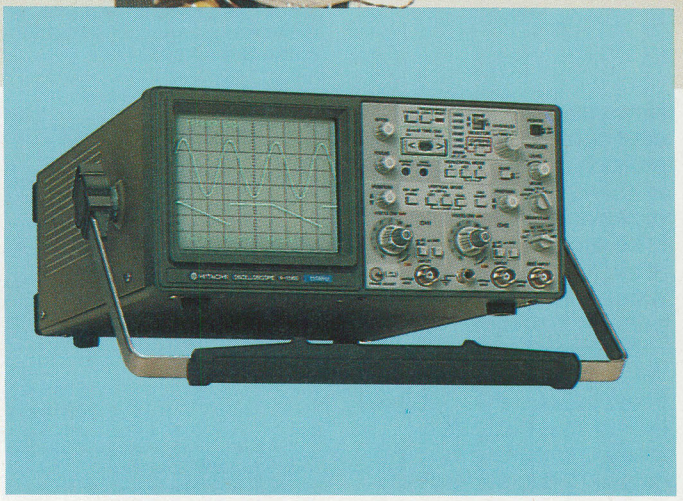

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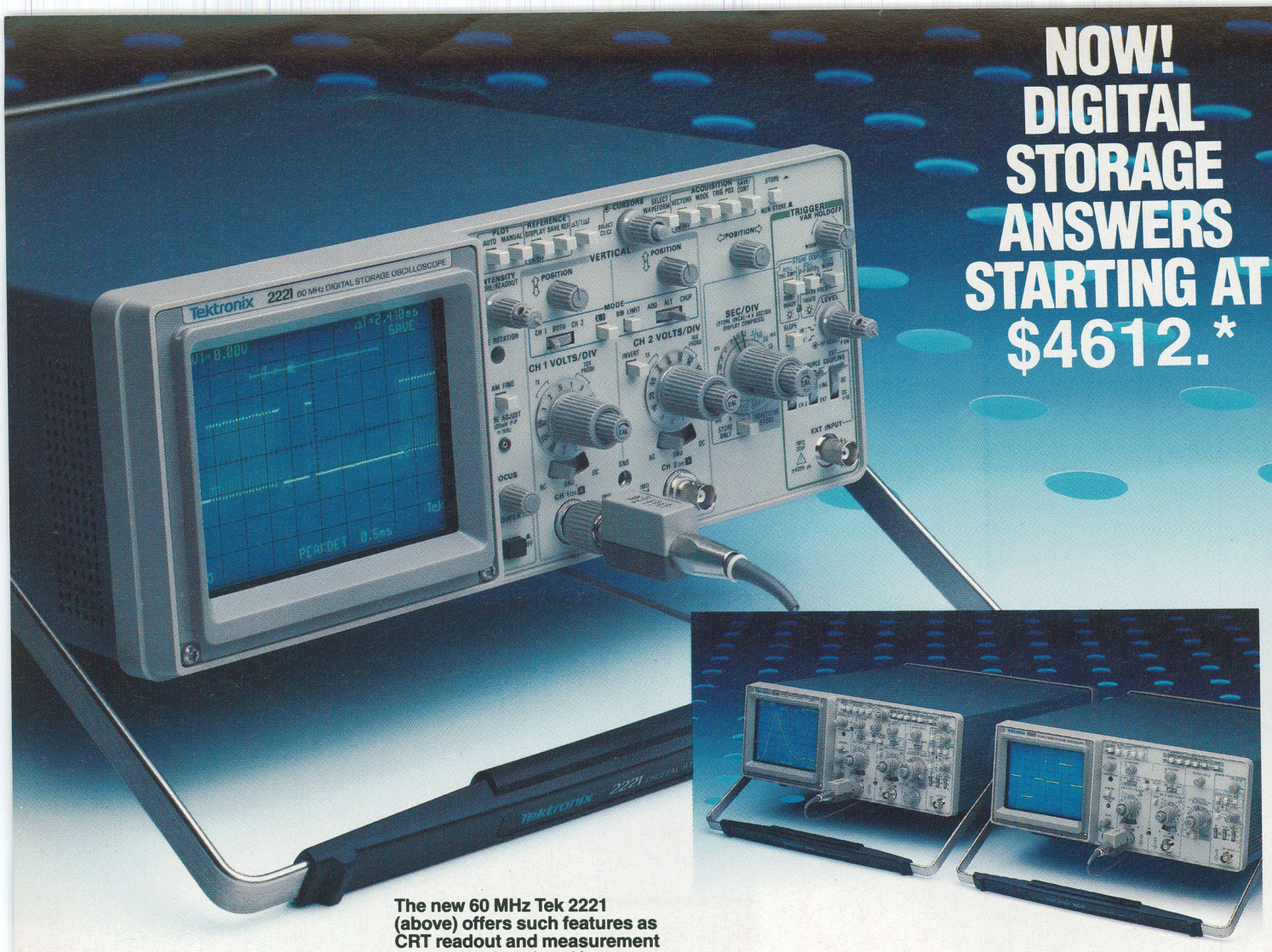

The new 60 MHz Tek 2221 (above) offers such features as CRT readout and measurement cursors for just $6152*

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Discover the potential! With digital storage you can freeze waveforms. Capture events invisible to non-storage scopes. Find signals buried in noise. And build a library of reference waveforms.

CRT readout and cursors distinguish the new 2221. For even higher performance, there's the 100 MHz, dual time base 2230 with optional battery-backed memory for saving up to 26 waveform sets. And if it's economy you want, choose the 60 MHz 2220 with many of the same features at an even lower cost.

With each scope you can automate measurements with interface options. And output direct to a printer or plotter. Tek software is available for systems.

Features	2230	NEW! 2221	2220
Analog/Digital Storage BW	100 MHz	60 MHz	60 MHz
Maximum Sampling Speed	20 MS/s	20 MS/s	20 MS/s
Record Length	4K/1K (selectable)	4K	4K
Peak Detect	100 ns	100 ns	100 ns
Save Reference Memory	One, 4K Three, 1K	One, 4K	One, 4K
Vertical Resolution	8 bits 10 bits (AVG mode) 12 bits (AVG mode over the bus)	8 bits 10 bits (AVG mode)	8 bits
CRT Readout/Cursors	Yes	Yes	No
GPIB/RS-232-C Options	Yes ($750)	Yes ($500)	Yes ($500)
Battery-Backed Memory (save 26 waveform sets)	Yes (inc with GPIB/RS-232-C)	No	No
Warranty	3 year on labor and parts, including the CRT		
Price	**$7692***	**$6152***	**$4612***

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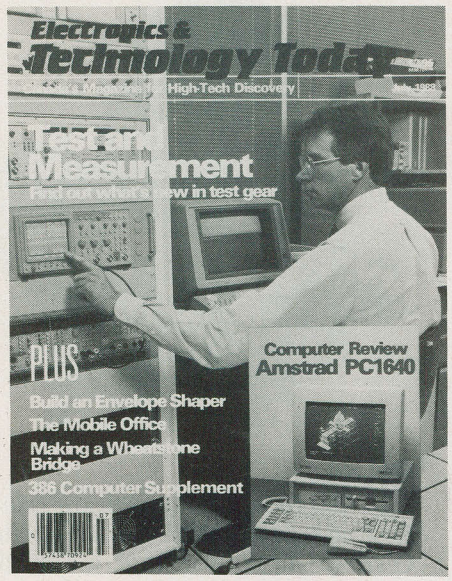
Volume 12, Number 7 July 1988



Our Cover

The test equipment photo is courtesy of Tektronix Canada; the Amstrad photo is courtesy of AudioVideo Specialists.

Please Note

We value input from our readers, but we regret that the editorial department is unable to answer telephone queries. If you have difficulties or suggestions, please write to us, enclosing a stamped self-addressed envelope, and we will answer you as soon as possible.

FEATURES

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PRODUCT REVIEW

PROJECTS

INFORMATION

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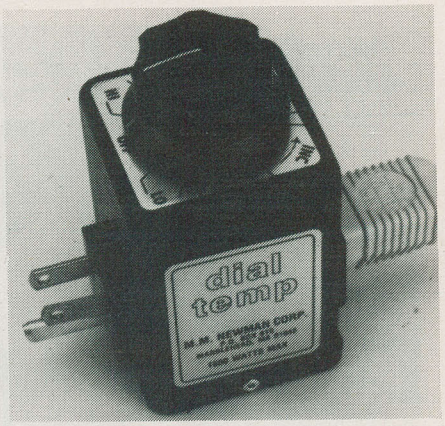
FOR YOUR INFORMATION

Soldering Iron Controller

The Newman Corporation of Massachusetts announces an adjustable temperature controller which will control irons from 15 to 1600 watts, at temperatures from 150° F to full heat. The unit is plugged into any outlet and the iron plugged into the controller.



Circle No. 4 on Reader Service Card

OS, too

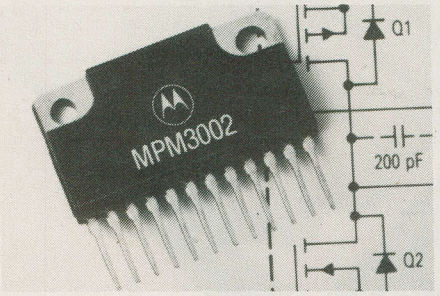
Byte Magazine announced that a poll of 5,000 computer professionals showed that OS/2, MS-DOS, and Unix will be the dominant operating systems by 1992. Since there are no other major contenders for micro operating systems, this seems to be a safe prediction.

Cassette Changer

Mitsubishi Electric Sales Canada Inc. announces the arrival of the TX-L50 Portable Audio system with a 5-cassette automatic changer. The changer can play both sides of up to 5 cassettes in order, with instant manual access to either side of any cassette. It features full logic control, an AM/FM tuner, a 3-band equalizer, Dolby B, metal tape compatibility, 2-way bookshelf speakers and more.

Circle No. 5 on Reader Service Card

MOSFET Bridge



Motorola has introduced the MPM3002, a power MOSFET H-bridge module which does not require isolating hardware. It is rated at 100V, 8A and has a power rating of 62.5W. The MPM3002 will be used in applications such as servo motor drives, stepper motors and switching power supplies.

Circle No. 6 on Reader Service Card

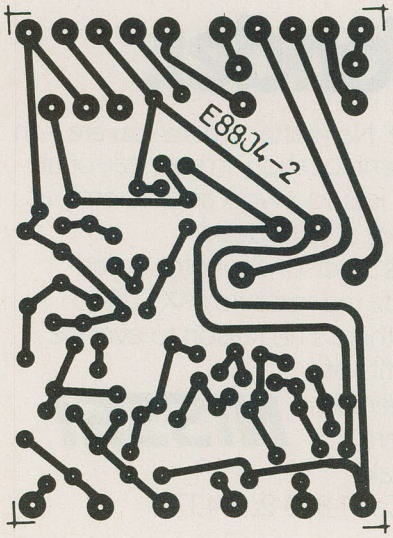
New APT Rep

Advanced Power Technology, manufacturers of high-power MOSFETS, announce their Eastern Canadian sales representative: Clarke- Hurman Associates, 66 Colonnade Road, Nepean, Ontario K2E 7J5, (613) 727-5626.

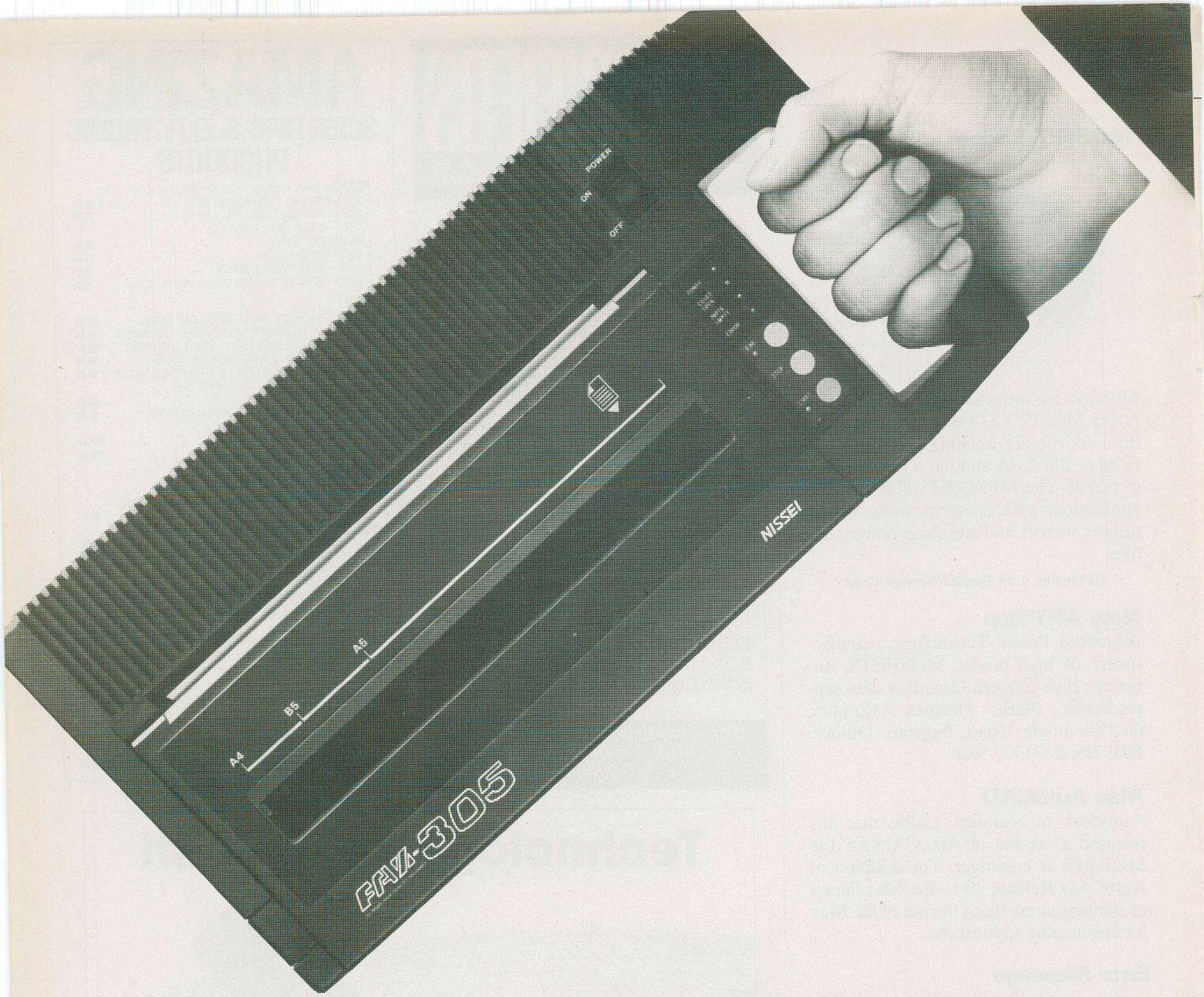
Mac AutoCAD

Autodesk of Saualito, California, has released a version of AutoCAD for the Macintosh II computer. The addition of AutoCAD Release 10 to the Mac lineup of software strengthens the use of the Mac for engineering applications.

Error Message



Blush, blush. In the June issue, we published the wrong printed circuit for the Electronic Combo Lock project. The correct PCB is shown above.



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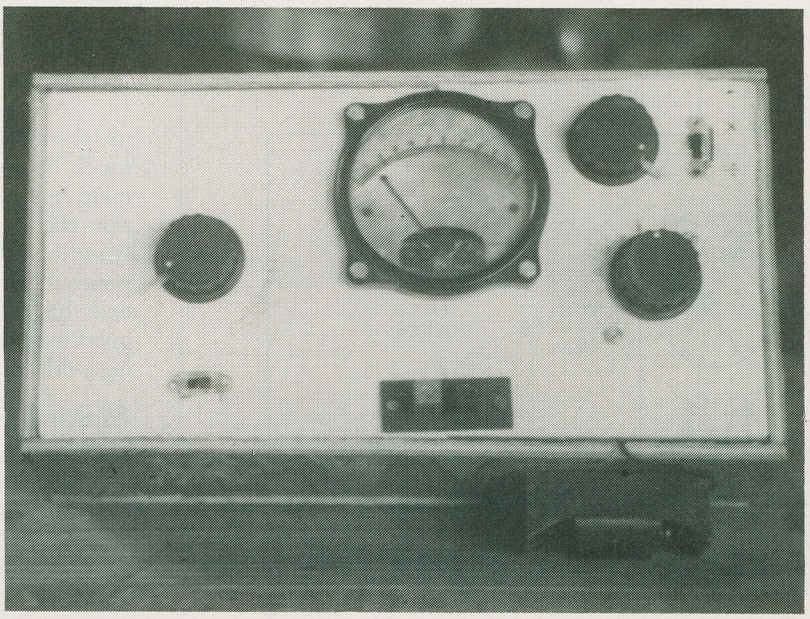
Making a Wheatstone Bridge

Ingenuity can often substitute when test gear isn't available.

J.N.M. LEGATE



Now that reasonably priced instruments with ohmmeter scales are readily available, the Wheatstone Bridge is rarely mentioned as a tool for measurement of resistance. However, my own experience of measuring anything other than medium values on an old analogue meter, particularly when coping with battery drift on low resistance and the difficulty of accurately reading high values on the non-linear scale, made me wonder if I could rig up a Wheatstone Bridge assembly to give reasonable accuracy over a fairly wide range of values without costing a lot. Perhaps a digital instrument would be a better answer, but I haven't got one and cannot really justify the expense for quite limited usage.

The principle of the bridge is quite straightforward, the basic circuit being shown in Fig. 1. R1 and R2 are the "ratio arms", R3 the "measurement arm", and Rx the unknown value to be measured. When the ratio and measurement arms are set to give zero deflection on the sensitive meter, the value of Rx is (R2 x R3)/Rl. Accuracy is entirely dependent on the accuracy of the resistances and the sensitivity of the instrument, and meter accuracy is not significant.

There used to be two versions of the commercially available bridges, both using high precision noninductive resistors from 1 to 5 or 10 thousand ohms, either in steps of 1,2,2,5 units, tens hundreds and thousands, or 1-10 in units, tens, etc, selected by a system of accurately machined low contact resistance brass plugs, the whole arrangement being well beyond my capabilities of copying, so I gave some thought to alternative possibilities.

Binary Switching

A binary system of switching seemed to be a suitable starting point, as 1, 2, 4, 8 values would give 15 unitary steps from 1 to 15, so using 100 ohm units would give 100 to 1500 ohms in 100 ohm steps and the 100 ohm gap could be filled by a variable unit. Similarly, if R2 was made 100 ohms and R1 selectable at 100, 1k, 10k and 100k, ratios of 1 to 100 would be obtainable, and interchanging the ratio arms would extend ratios down to 1/100, all without requiring large numbers of units. Moreover, Radio Shack has a kit of 50 metal film resistors, 1%, from 10 to 1M values that seemed to cover requirements. However, the method of binary switching was not immediately obvious. A four deck rotary switch with 10 or more positions was a possibility, but apart from not being able to find one, I was not happy that durability and convenience of operation would be satisfactory, so eventually I managed to concoct a somewhat unorthodox device that worked.

The heart of the gadget was a "camshaft" to operate four roller lever microswitches (also Radio Shack). A wooden cotton reel was used for convenience, as it already had a centred hole to take a bit of 1/4" dowel rod as a spindle. The cams were made up from 1/16" aluminum strip. No doubt the sizes could be derived by measuring the reel diameter and calculating lengths, but I took the easy way by putting a piece of masking tape round the reel, marking the length and then removing the tape and marking out the sixteen equal divisions. It was then quite easy to stick the marked tape on to a piece of aluminum sheet and cut the various "cams" from this pattern.

In practice I found it best to cut 1/4" wide strips, bend them round a broom handle until they were more or less to the

Making a Wheatstone Bridge

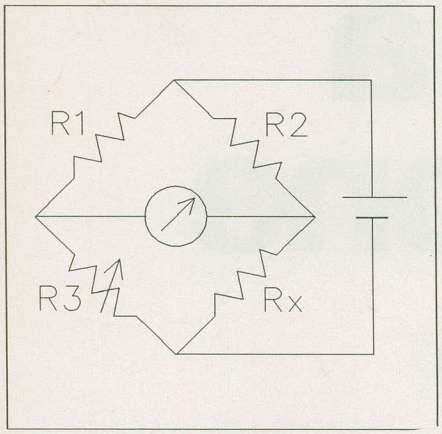


Fig. 1. The basic bridge. When the bridge is balanced, there will be zero volts across the meter. If R2 is 10 times R1, the ratio is 10, and if the arms are interchanged the ratio is 0.1.

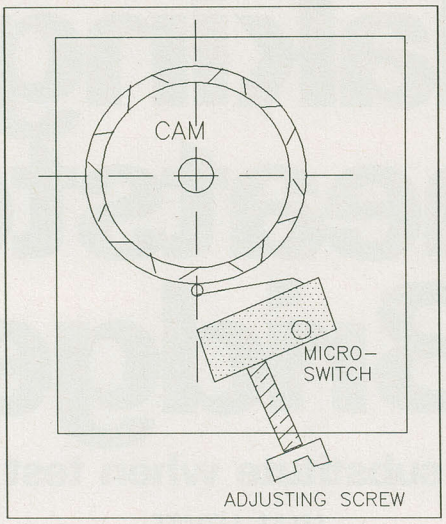


Fig. 2. The cam switch mounting.

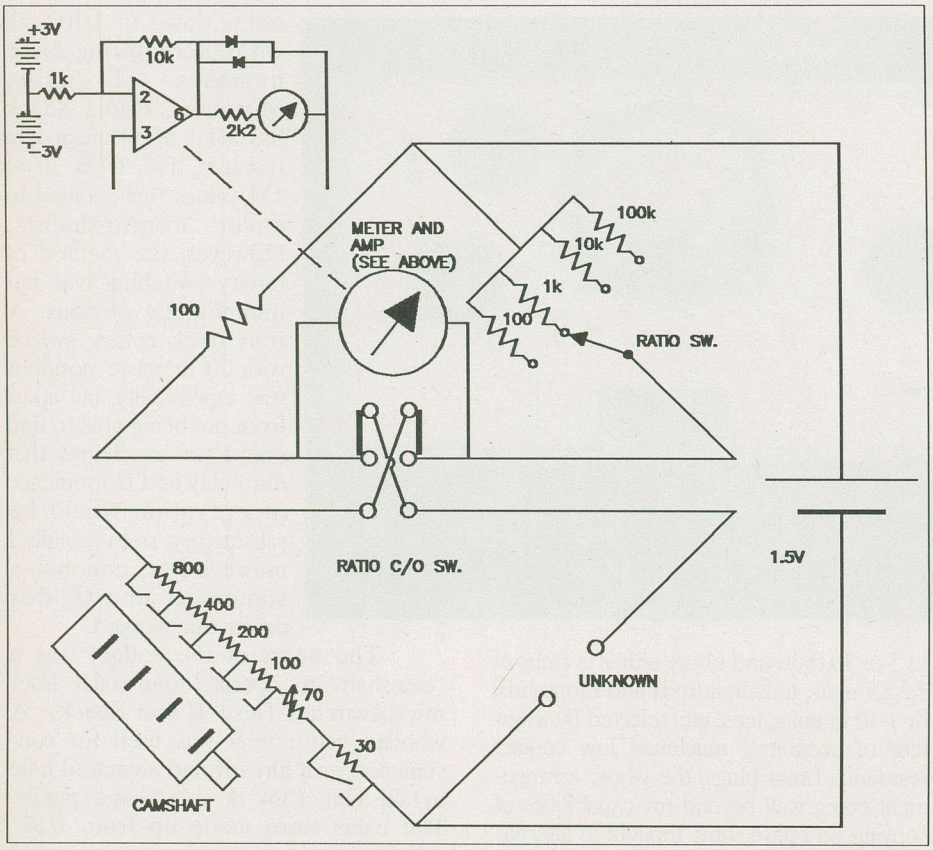


Fig. 1a. The bridge circuit as actually used.

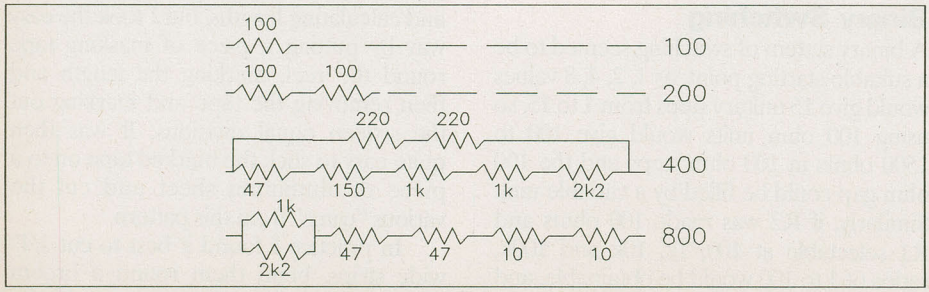


Fig. 3. Making up R3 with various resistor combinations.

curve of the reel surface, and then cut to length, as this ensured that the strips lay reasonably accurately on the reel. I drilled small holes to take brads for securing the strips to the reel, but epoxy or Crazy Glue would probably give a perfectly satisfactory bond. The end of each strip should be filed to approximately 45° to prevent stubbing of the roller levers.

Final assembly turned out to be more complicated than I had expected. It proved to be unsatisfactory to use the two mounting holes in the lever switches, as minor inaccuracies in the cam heights together with the imprecise operating points of the switches would not permit rigid mounting, and I ended up by pivoting the switches on one mounting hole and setting their individual positions by trial and error with screw adjusted stops as indicated in Fig. 2. As space was rather tight I used Loctite rather than locknuts to secure the screws.

No doubt anyone with reasonable metalworking facilities could make up a much better mechanical assembly than mine, but the arrangement of 1/4" wooden side cheeks drilled to take the camshaft spindle and switch support (a scrap poprivet wire) held by bent sheet metal ends has held together so far. However, apart from the switch setting screws, nothing is critical.

Making R3

There was a certain amount of improvisation in getting the exact values of resistance steps; I concocted these as indicated in Fig. 3, since the resistor kit did not provide all the required units. Consequently, the nominal 400 ohm step was theoretically 399.95 and the nominal 800 ohm step 801.5, both well inside the 1% nominal accuracy of the resistors. In fact, if I hadn't been feeling rather niggardly, a second kit of resistors would have reduced the amount of fiddling.

The only remaining point of importance was then the means of indication, and there is quite a lot of scope for alternatives. My approach was to assume that it is possible to detect about one thousandth of full scale of an instrument, so that one microamp is visible on a 2" scale millimeter, or .05 microamps on a 50 microamp movement, although this may be stretching things somewhat. The instrument deflection is defined by the out-of-balance voltage across it and the internal resistance of the instrument. As a 1mA movement is perhaps between 10 and 100 Ohms, and a 50 microamp movement be-

tween 1 and 2k typically, a 1% error in setting the measuring arm would give about 1.25 mV across the instrument when measuring a nominal 1 megohm value, or about 150 microvolts when measuring a nominal 1 ohm with a 1.5V battery on the bridge. So detection might be possible by direct readings, but such small movements would be rather difficult to work with. I inserted a 741 op amp, with moderate gain, to step up the sensitivity.

tally, it is most essential to have some protection for the instrument to avoid wild overswinging when well off balance, and even when near balance to cater for the indeterminate situations between steps due to the inherent inaccuracies of cam positions and the somewhat uncertain points of operation of the quick action microswitches. The back-to-back diode system is perfectly adequate, bearing in mind that no more than about .7V appears across silicon diodes, or about .3V with germanium units. The base/emitter or base/collector connection in transistors could be used, if you make sure you get the polarities right. Instruments can usually take quite heavy overloads for short periods and limiting the current to about twice full scale will not cause damage if the needle hits the end stops, so the series resistance can be of a value such that the total resistance across the diodes — i.e. coil plus external resistance — only passes about twice full scale current with .7 or .3 volts. Some trial and error may be required to get an acceptable performance.

The physical arrangement of the bridge is a matter of personal preference. The variable resistance I used was far too big and was actually a 70-ohm field rheostat about 50 years old that was wound in three grades of wire, so that the scale was by no means linear, but was capable of being calibrated reasonably. The missing 30 Ohms was inserted to extend the value when necessary — a rather crude set up that would be greatly improved by using a 100 ohm linear potentiometer. You will by now have realized that my arrangement was a long way from an ideal one, but in practice it turned out to do all I wanted, cost very little, and was an entertaining exercise to try out.

No doubt there is very limited use for such a scheme, but I hadn't seen the idea of a camshaft switching method of selecting a binary sequence and it seemed that it might be useful not only for this bridge scheme, but possibly for other requirements, and it would of course be quite possible to add extra stages, probably with a bigger camshaft. For example, one extra cam and switch covering 32 steps would give 31 unit steps, but it would almost certainly require at least a 2" diameter for the camshaft. Incidentally, the micro switches have normally-open and normally- closed contacts, so either clockwise or anticlockwise rotation can increase the resistance value. Thus you could have a fixed scale on the panel or the knob depending on preference.

As I had made no attempt to get a professional arrangement I have not gone into much detail of construction, but have given some idea on improvising a useable system. I used a small piece of Veroboard to mount the string of resistors, though it would be more elegant to produce a printed circuit to carry the resistors and the op amp details, and panel layout is very much a matter of personal preference. ■

FEATURE

Introducing Microprocessors Part 5

This month we examine the different types of computer memories.

MIKE TOOLEY

The general learning objectives for Part 5 are that readers should be able to:
(a) Understand the characteristics and applications of semiconductor read-only memory (3.1).
(b) Understand the characteristics and applications of semiconductor random-access memory (3.2).
(c) Understand memory maps for typical 8-bit microprocessor based systems (3.3).
The specific objectives for Part 5 are as follows:

3.1 Semiconductor Ready-Only Memory

3.1.1 State why read-only memory is needed.
3.1.2 Give examples of the use of ROM devices to implement read-only memories.
3.1.3 Explain, in simple terms, the arrangement of a semiconductor read-only memory cell matrix.
3.1.4 Distinguish between mask-programmed or fusible-link (PROM) and erasable-programmable (EPROM) devices, state typical applications and give relative costs.
3.1.5 Explain, in simple terms, the process of programming mask- programmed, fusible-link, and erasable-programmable ROM devices and explain the process of erasure.

3.2 Semiconductor Random-Access Memory

3.2.1 State the need for read/write memory and distinguish between read/write memory and read-only memory.
3.2.2 State that semiconductor random-access memory (RAM) provides read-write memory of a transient nature.
3.2.3 State typical applications of random-access memory.
3.2.4 Explain, in simple terms, the arrangement of a semiconductor random-access memory cell matrix, and how it is accessed.
3.2.5 Distinguish between static and dynamic RAM.

Memory Maps

3.3.1 Explain the need for a memory map.
3.3.2 Draw and interpret the memory map for a representative microcomputer system showing addresses in both decimal and hexadecimal form.
3.3.3 Explain the allocation of total memory space available in a representative microprocessor-based system.

Storage

All microprocessor-based systems require a means of storing their control programs (or operating systems), applications programs and data. Furthermore, the microprocessor itself will require some means of storing transient data (e.g. variables used in a program) and implementing a stack.

Storage may take a variety of different forms including magnetic tape, magnetic disk, and semiconductor memories. Indeed, microprocessor-based systems are often designed so that they can take advantage of more than one storage method. A simple home computer, for example, will contain semiconductor memory devices to satisfy the needs of the microprocessor and to provide storage for a BASIC interpreter. The computer may also be able to save and load programs and data using an external cassette tape recorder or disk drive.

The types of storage device which are relevant are the semiconductor read-only memory (ROM) and semiconductor random access memory (RAM). These devices are both simple and compact. Furthermore, when compared with magnetic disk and tape storage, they offer very fast access times.

Ready-only versus read/write memory

The term "read-only" applies to a wide variety of memory types and all provide permanent or semi-permanent storage and, whilst the contents of a read-only memory cannot normally be changed, certain types of read-only memories may be re-programmed. Read/write memories, on the other hand, allow both reading and writing to take place and their contents can be modified at will.
Unlike magnetic disk and tape (which both exhibit read/write characteristics), the data stored in a semiconductor read/write memory will, unless special precautions are taken in the form of a battery-backed supply, be lost when the power is switched off. Such memories are thus often said to be "volatile". Semiconductor read-only memories, on the other hand, are permanently programmed and thus are said to be "non-volatile".

Random access memory

Semiconductor read/write memory is usually implemented by so- called "random access" memories (RAM). The term "random access" simply indicates that one can access stored data anywhere within the memory with equal ease. Readers should contrast this form of memory with the "sequential access" form of read/write memory provided by magnetic tape in which data is stored one item after another.

Semiconductor Read-Only Memory (ROM)

Microprocessors require non-volatile storage for their control programs and, where appropriate, operating systems and

Continued on page29

NRI Hands-On Training With an IBM PC Compatible Plus 20 Meg Hard Disk

GET THE KNOW-HOW TO SERVICE EVERY COMPUTER ON THIS PAGE

Learn the Basics the NRI Way—and Earn Good Money Troubleshooting Any Brand of Computer

The Department of Labor ranks computer service high on its list of top growth fields, with accelerated demand creating more than 30,000 *new* jobs within the next 10 years.

You can cash in on this opportunity—either as a full-time corporate technician or an independent serviceperson—once you've learned all the basics of computers the NRI way. NRI's practical combination of "reason-why" theory and "hands-on" building skills starts you with the fundamentals of electronics, then guides you through advanced electronic circuitry and on into computer electronics. You also learn to program in BASIC and machine language, the essential languages for troubleshooting and repair.

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REVIEW

Amstrad PC1640

The PC1640 stands out from the parade of look-alike, work-alike PC compatibles.

BILL MARKWICK

After you've tried dozens of beige boxes with monitors sitting on them, it becomes difficult to work up any enthusiasm about one more MS-DOS computer. The Amstrad PC1640 changed my mind about that.

Setting Up

Amstrad provides three choices of monitors (monochrome, color and enhanced color) and three choices of storage (one floppy, two floppies, or one floppy and a 20M hard drive). We received the ECD enhanced colour display and the hard drive version.

On first unpacking the computer, you'll notice that the cabinet is far smaller and lighter than the usual IBM compatible. On the top is a rectangular socket for holding the monitor base, and in the socket is a holder for four AA dry cells. The cells run the clock, and also power a section of RAM that holds the configuration options that you can choose. If you find AA cells in the cabinet top to be a bit odd, consider what happens when your usual internal lithium batteries go dead (especially on an AT compatible): the computer dies, startup information is lost, and you're out of business until you can locate a vendor for the lithium types. With the Amstrad, you merely replace the batteries once a year while the power is on, and nothing is interrupted. By the way, the batteries were included.

Remove the small lid at the rear top, and you'll see three full-sized IBM-compatible card slots. Not as many as the dedicated computer hacker would like, but then there are no slots taken up by the ports, video or drive controllers, all of which are on the motherboard. The card slots face out of the right-hand side of the cabinet.

On the rear you'll find a DIP switch for the type of monitor, a 9- pin video output, and D-connectors for the serial port and parallel port. There's also a DIN-type connector for the DC power. The DC? Yes, indeed. Now you can see why the computer is so small and light: the power supply is in the monitor. Monitors already have a hefty transformer in them anyway, so this method doesn't make the Amstrad display noticeably larger. It means that you must use an Amstrad monitor, of course, but you'll save a lot of desktop space.

The monitor sits securely in its cutout on top of the cabinet, and can be adjusted for angle because its mounted with a swivel joint. The usefulness of the cutout becomes clear when you adjust the angle; the

monitor doesn't require both hands to keep it from skating around.

The video card in the PC1640 can emulate three different standards, so set the DIP switch for the type of monitor you have: 720 by 350 hi-res monochrome (Hercules compatible), 640 by 200 RGB (CGA compatible), or 640 by 350 enhanced (EGA compatible). You won't have to go poking around inside — the switch is easily accessible from the back panel.

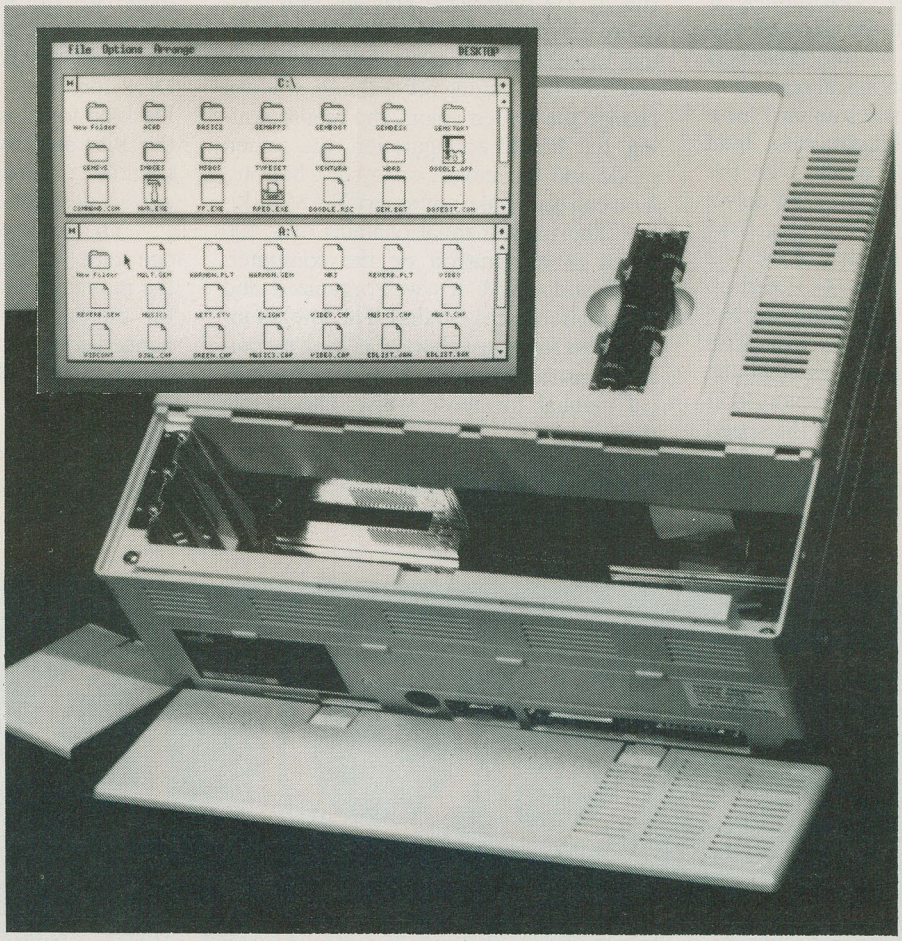
On the left are the connectors for the keyboard and included trackball mouse, and on the back of the keyboard itself is a connector for an optional joystick. And, bless 'em, a *volume control* so you can turn down DOS's incessant beeping.

Switching On

After a brief pause, which is a memory check, the PC1640 booted up from the hard drive and showed the familiar prompt (from MS- DOS 3.2). DOS users will be on familiar territory, but for those who are intimidated by the command prompt and its hieroglyphics, there's an alternative. The GEM desktop manager is included, a system that gives the DOS computer an icon environment not unlike that of the Macintosh. Those who hate learning command strings can simply mouse the cursor over to a program folder and copy, delete, run, and so on. While I'm not a fan of the icon system, feeling as I do that it's an unnecessary intervening step and doesn't provide enough information, I have the greatest sympathy for those who just want a computer for a certain task or two, and hate the complicated command syntax of DOS. GEM is an excellent alternative.

Other software included with GEM is a small word processor, a small paint program ("Doodle"), a large paint program (GEM Paint), and BASIC. There's also a calculator, a utility to write the current screen display to a file, an alarm clock and a print spooler. The BASIC, from Locomotive Software, makes good use of GEM's windowing capability, so that your program lists in one window while it runs in another. As with other similar programs, the windows can be sized and moved around.

The quality of the GEM screen on our enhanced color display was superbly crisp and clear, and so were the BASIC graphics and the text displayed by my word processor.



The interior of the cabinet has three full-size expansion slots; the rear panel has one serial and one parallel port. (Inset) The GEM Desktop software gives DOS users an icon system similar to the Macintosh.

Software Tryouts

Suppose you have software which is designed to run only in the low-res CGA mode, but you have the enhanced display. No problem. A program called Display will reset the screen to emulate the CGA, and all my CGA software ran perfectly.

AutoCAD in the EGA mode lacks the resolution of the Hercules mode, but the color capability more than makes up for this. You can select one of 16 colors for each layer, making it very easy to see what's what, particularly on complex drawings. For instance, I like to put all curved objects on one layer, all hatching on another, and all text on yet another, because these are the functions that slow AutoCAD down the most. I can then turn off unneeded layers to increase the drawing speed. It's easy to see if you're putting new objects on the right layer, and easy to see if you've turned them on or off.

Incidentally, the mouse and its driver, which is automatically loaded by the Autoexec file, emulates the Microsoft mouse, a type which appears in the installation menu of every piece of popular software that uses mousing. I had no trouble at all with the mouse operation with any software; it worked first time, every time. On top of that, it even worked with WordStar (Version 4), and let me cursor around the screen much faster than with the keyboard, a feature I came to really like.

WordStar 4's configuration program, incidentally, allows the user to set the EGA mode to give 43 lines of text instead of 25. You can see more text, but it's not all that easy to read because of the smaller characters. You win some, you lose some...

The Xerox Ventura desktop publishing system looks great in the EGA mode. Actually, it was the only software to cause any sort of a problem, though a minor one. The reason is that Ventura comes with its own version of GEM, which must be installed during the initial loading. When I tried to run Ventura from the Amstrad GEM, I got an insufficient-memory error message. I assume that Ventura was attempting to run GEM-within-a-GEM. The cure was to run Ventura from the DOS prompt (or write a batch file to do this for you). This was the one and only hitch I encountered.

My printer, an Epson LX-80 which

emulates an IBM graphics printer, worked every time with all programs in both text and graphics modes.

Under the Hood

The PC1640 has the full 640K of memory (an unfortunate limit imposed by Microsoft back in the good old days when 640K was thought to be more than you could ever use). The processor is an 8086 running at 8MHz. The 8086 used to be a sort of lost soul among the CPUs — the 8088 was IBM's choice for an economical computer, and it became the industry standard for a long time, despite its 8-bit data buss. Intel also provided the 8086, exactly like the 8088 but with a true 16-bit buss, but only a few manufacturers used it. Now that IBM is using it for the lower models of the PS2 line, it's catching on as a way to speed up the PC compatible without increasing the cost much. The gain in speed over the 8088 is about 10%, depending on how much the software uses the data buss. The Norton SI rating is 1.9, or just about twice the speed of a 4.77MHz PC.

The hard disk operating speed is fast, though not the fastest. It's not particularly slow during loading or saving, but slightly affects programs like Ventura, which access the hard disk for just about everything in order to free up lots of RAM. I don't mean that it's bothersome, just noticeably different from my own very fast disk (a NEC 20M).

There's a program included called NVR (for non-volatile-RAM — the RAM run by the batteries). This lets you configure a number of different parameters so that they'll be the way you want whenever you boot up. Among other things, you can change the screen colors, the mouse scaling, the RS232 configuration, the screen mode and the mouse or joystick buttons. You can also make any size of RAM disk.

The thick manual contains over 500 pages of information on the computer, DOS and GEM. It's well-organized and information is easy to find. The level of instruction stops just short of getting technical; Amstrad provides an optional technical manual for those who'd like to dig deeper.

Design Excellence

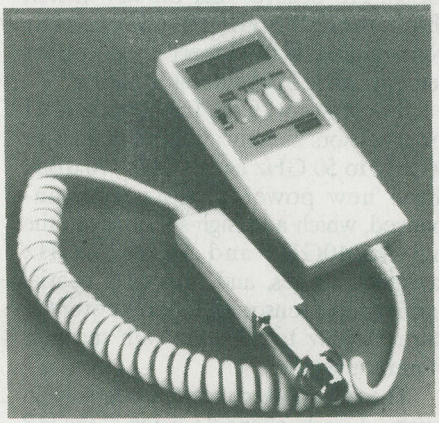
If we gave design awards, my vote would go to the PC1640. It's the only computer I've come across that's designed totally for the customer, instead of for the convenience of the engineers or production line. Everything on the computer worked with every piece of software and hardware I tried; I didn't have to make phone calls and run little utility programs or start rooting in the innards for jumper wires. Then there are the little touches: the volume control, the mouse port, the external battery holder. The computer arrives with DOS for those who prefer it, and GEM Desktop for those who don't care to learn the bits and bytes. The phrase "user-friendly" is much overworked, but it's the perfect description of the Amstrad.

The suggested list price of the package starts at $1599 for a single-floppy with the monochrome monitor, up to $2999.95 for the hard disk version with the enhanced color monitor; dealers usually discount prices below these figures. You'll find the PC1640 at local computer stores, but if you can't locate a dealer, the distributor is AudioVideo Specialists Inc., 2134 Trans Canada Hwy S., Montreal, Quebec H9P 2N4, (514) 683-1771. ■

Test & Measurement Equipment

Infrared Thermometer

RCC Electronics introduces the EBRO EB-ET 330 Infrared Thermometer. This non-contact, hand-held thermometer measures ranges from 0 to 300°C and is switchable between Centigrade and Fahrenheit readings. The EB-IT 330 can calculate maximum, average, and minimum over a range of 5 hours. Emissivity can be set from 1.00 to 0.10 in 0.01 increments to match the emissivity of the material to be measured. RCC Electronics Ltd.



Circle No. 12 on Reader Service Card

Calibrator Source

Keithley Instruments introduces a new multifunction calibrator/source capable of calibrating electrometers and picoammeters and accurately sourcing very low currents. Keithley's new Model 263 Calibrator/Source makes electrometer/picoammeter calibration easier, with simpler interconnections, a built-in 20V active or passive source, a wide calibration range and an accuracy four times better than the unit it's designed to calibrate. The 263 can source full range current from 2pA to 20mA, with greater accuracy and precision than that found in general purpose sources. This is particularly useful for calibrating instruments that require precise and very low level dc currents. Other output ranges include full scale charge values from 20pC to 20uC, voltage from 200mV to 20V and resistance from 1kohm to 100Gohm. Keithley Instruments Inc.

Circle No. 13 on Reader Service Card

Remote Control Tester

This new Remote Control Transmitter Tester, now available from Philips ECG, features an LED go/no go test and a frequency counter test jack to simplify and expedite diagnosis of faulty remote control systems. The RCT7501 can be used to test all types of remote controls, both ultrasonic and infrared, used with TVs, VCRs, cable converters, compact audio and video disc players and the newer AM/FM receivers. The unit's go/no go function test detects transducer output directly without electrical connections and provides positive LED indication of transmitter output. When used for field service, the unit makes it unnecessary to return equipment to the shop if the fault is in the transmitter and not the receiver.

The output jack and connecting cable enable the RCT7501 to be used with Oscilloscopes or Frequency Counters for observation of pulse codes or frequencies for more accurate testing of suspect transmitters. Philips ECG.

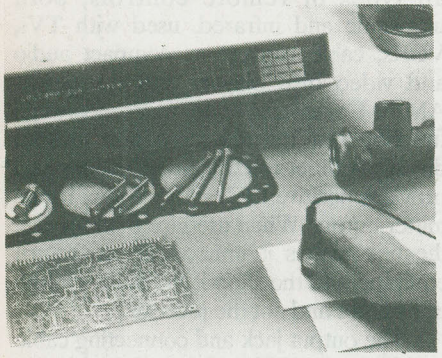
Circle No. 14 on Reader Service Card

Thickness Measuring Test System

Operating on eddy current and electromagnetic-induction principles, the tester automatically measures thicknesses of nonconductive coatings on nonmagnetic metals and nonmagnetic coatings on magnetic substrates.

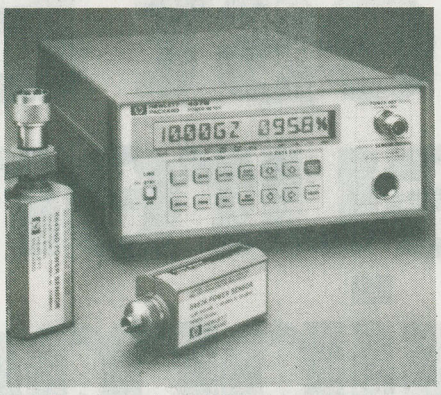
The Eddy-Mag 2000 is particularly suited to such applications as paint on aluminum, brass or steel; anodize on aluminum; cadmium, tin, zinc, nickel, copper, chrome, teflon, or enamel on steel; copper on non-conductives and many other combinations used in industry.

Simple to operate, the tester with advanced microprocessor circuitry consists of a rugged tabletop LED display unit with user prompting, memory and direct measurement readout working with probe, probe guide and printer. Memory is non-volatile and retained even if the unit is unplugged, eliminating the need for recalibration. The memory bank can store calibration data for up to 64 measurement applications. CMI International.



Circle No. 15 on Reader Service Card

RF Power Meter



HP has introduced the HP 437B power meter, a general-purpose single-channel programmable unit for the rf/microwave market. HP believes that the new meter, which includes HP-IB (IEEE-488) programming, is the lowest-priced power meter available in its class at $3,996*.

It operates with the full HP line of 11 power sensors already available that cover 100 kHz to 50 GHz and +44 to -70 dBm. Three new power sensors were announced, which add high-sensitivity to the 26.5- to 40GHz and 33- to 50GHz waveguide ranges, and provide a coaxial thermocouple sensor for coverage over the entire 50MHz to 50 GHz with the new 2.4mm connector.

The new power meter, essentially an improved single-channel version of the HP 438A dual-channel power meter, is designed for both manual benchtop as well as ATE applications; its compact front panel is 89 x 213 mm (3.5 x 8.4 inches). Hewlett-Packard.

Circle No. 16 on Reader Service Card

20MHz Digital Scope

The Signalcomputer SC 02 has a sampling rate of 20MHz per channel. This additional feature allows all the functions of a true dual channel digital storage scope even though it is a handheld device. Up to the maximum resolution of 50ns on both channels time relations can be measured with quartz precision up to 5ns. Programmable placement of the trigger on both channels provides accurate pre-trigger or post-trigger viewing.

In the multimeter mode a full DC compensation has been added. This feature allows improved resolution and precision, equal to that of a 3-1/2 direct current measuring instrument.

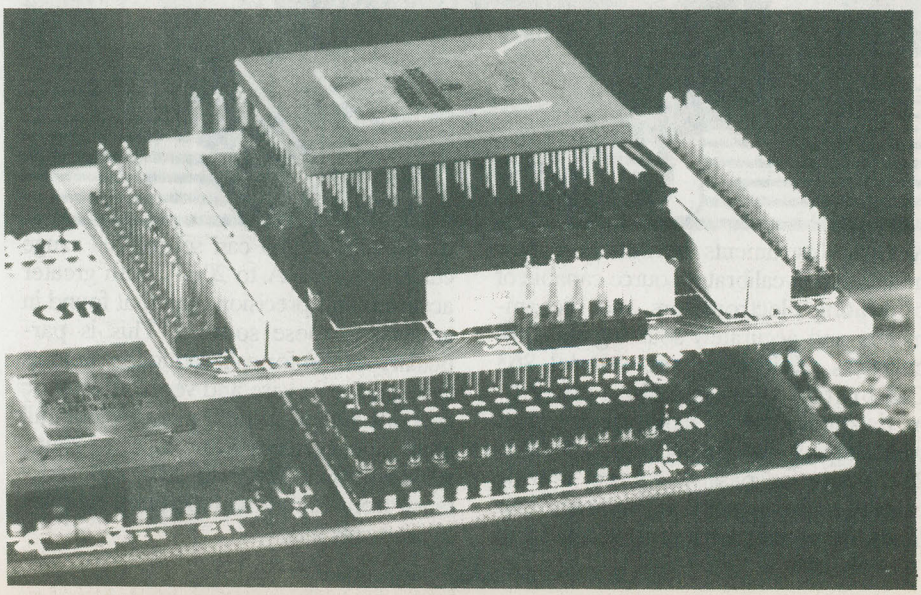
Other features include dual channel sampling, true rms measurements up to 1MHz, and frequency measurements up to 6MHz. RCC Electronics Ltd.

Circle No. 17 on Reader Service Card

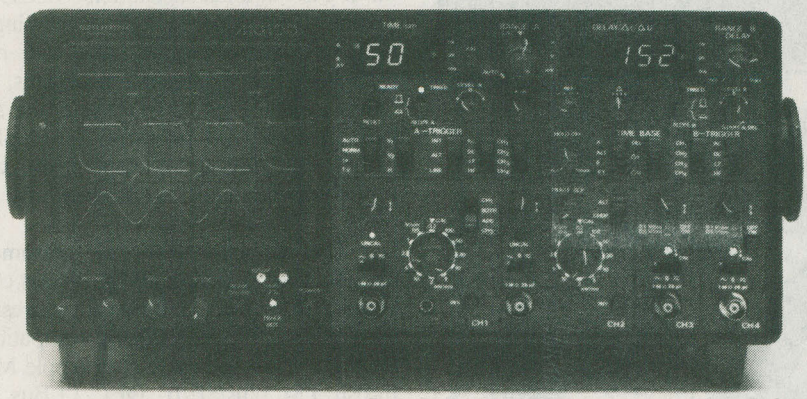
68020 Microprocessor Analysis

Gould Test and measurement announces the introduction of the 68020 MAP (Microprocessor Analysis Package) for its K450B Logic Analyzer. Gould's recent upgrade of the K450 analyzer from 48 to 80 channels allows it to further enhance the features of its 32- bit Microprocessor Analysis Packages. With 80 channel Gould is able to route each signal directly to the logic analyzer, rather than through a multiplexer where several CPU signals are combined into one analyzer channel. With no intervening circuitry to distort the true timing information, Gould's new analyzer can instantly switch between state measurements and 10 nsec timing when working with microprocessors. Allan Crawford Associates.

Circle No. 18 on Reader Service Card



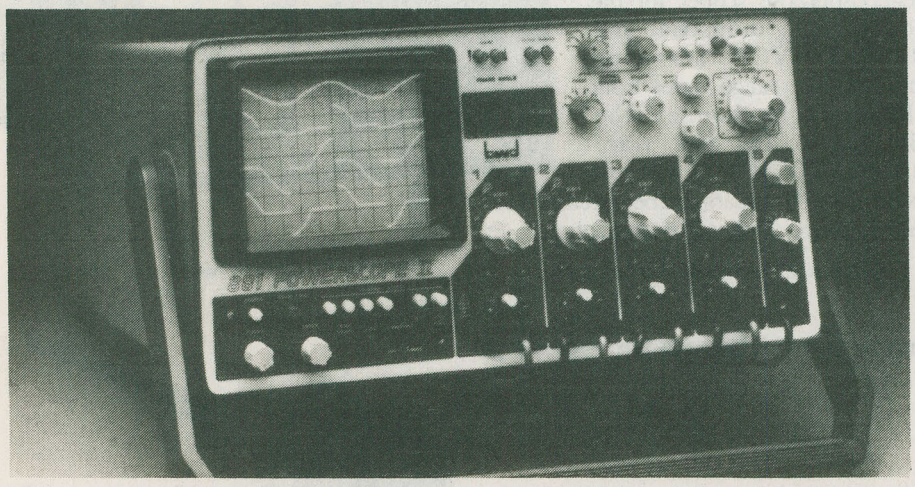
4-Channel Scope



The Grundig MO 100 100MHz oscilloscope has four true *Y* channels for observation of several signals. The time sweeps for channels 3 and 4 can be individually selected and are continuously adjustable. The automatic time range switching always selects the appropriate time base for the signal to be measured. A 7-segment LED displays the sweep time. Tradeport Electronics.

Circle No. 19 on Reader Service Card

5-Channel Power Scope



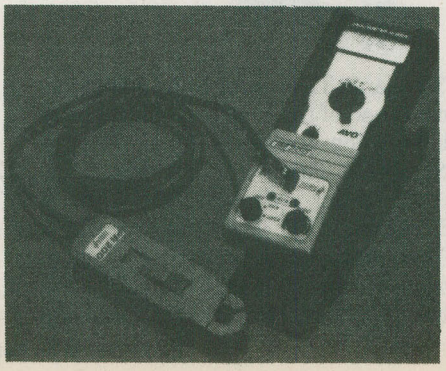
The Australian Powerscope II is aimed primarily, but not exclusively, at the power and control field. It has fully insulated front panel controls and can withstand 3,000 volt transients at the inputs. Four of the channels have 25MHz bandwidth and the fifth has a 50MHz bandwidth. The common mode rejection of 86dB allows examination of signals in virtually any type of circuit. Tradeport Electronics.

Circle No. 20 on Reader Service Card

AC/DC Current Adapter

Now available from HEME, the new PR-200 Hall Effect AC/DC current clamp-on probe which can be used with most multimeters, oscilloscopes and recorders, This dual range 20A and 200A unit has frequency response of DC to 10 KHZ and an accuracy of 1% of range. Accurate measurements and recording are now available with HEME's newest product, the PR-200. RCC Electronics.

Circle No. 21 on Reader Service Card



Clamp-on DMM

The ITT MX 1200S measures true RMS AC current and voltage, plus DC amperes up to 1,000. It also measures power to 200kW and apparent power to 200kVA. The MX 1200S has a frequency counter up to 1,000Hz, and a power factor range. It autoranges in all modes, and two analog outputs are provided. Tradeport Electronics.

Circle No. 22 on Reader Service Card

Digital Multimeter

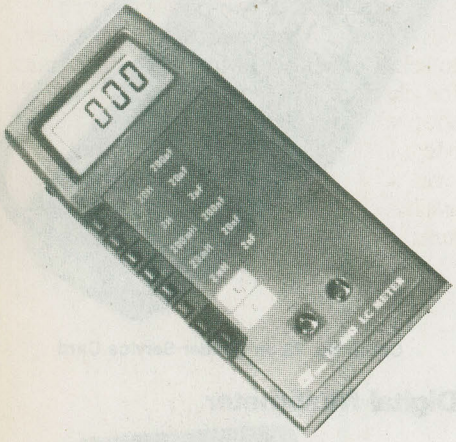
The MEGURO MD-30 is a low cost, highly reliable, 3-1/2 digit multimeter. It features selectable manual and auto ranging, continuity beeper and diode test range. The MD-30 measures AC voltage to 750V, DC voltage to 1000V, AC/DC current to 10A, resistance and provides built in overload protection. RCC Electronics.

Circle No. 23 on Reader Service Card

Test & Measurement Equipment

Digital LC Meter

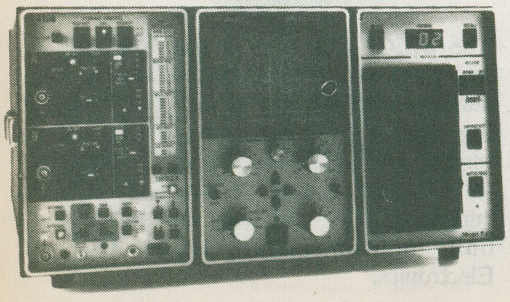
KB Electronics announces the addition of the LC 6043 Digital LC meter to its line of test bench equipment. This handheld portable meter covers 5 inductance ranges from 1uh to 20H and six capacitance ranges from 1pf to 200uf with a 1% accuracy rating. The 31/2 digit LCD display provides a clear visible readout in all lighting conditions. The unit features a fast sampling time of less than .5 sec. for efficiency of operations. The LC 6043 is equipped with an adjustable stand for easy use in either bench- top handheld applications. KB Electronics.



Circle No. 24 on Reader Service Card

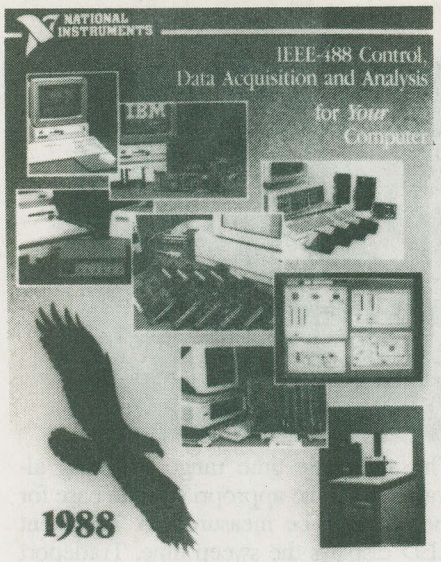
High Speed Digitizing Plug-in

The new Nicolet 4180 plug-in increases the data acquisition speed of the 4094 digital oscilloscope to 200MHz. Using the latest in ADC technology, the 4180 has simultaneous digitizing on both input channels. For multiple channel applications, two 4180's can be installed in one mainframe without degradation in speed on the four input channels. Waveframe memory lengths up to 16K data points means that sweeps as long as 80us can be acquired while maintaining the 5ns resolution. On-screen trigger level, sensitivity, and slope removes the guesswork commonly associated with transient capture. Nicolet Instruments.



Circle No. 25 on Reader Service Card

NI IEEE-488 Catalog

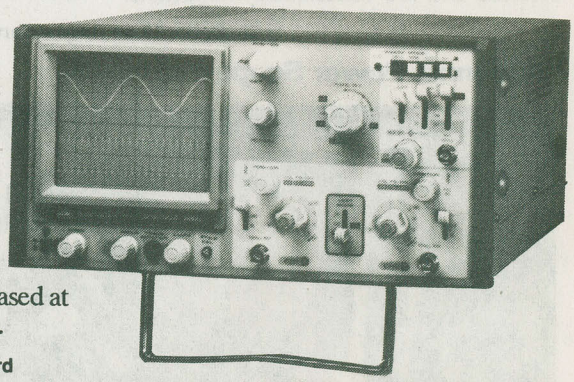


The 1988 catalog provides information on all of the National Instruments IEEE-488 products, which are used in developing instrument control applications with most micro- and minicomputer platforms, and contains details of new software and supporting hardware products for applications requiring data acquisition, data reduction data analysis, and data presentation.

The extensive National Instruments product line supports all the major computer architectures and bus structures, including IBM PC/XT/AT and compatibles, IBM Personal System/2 TM, Apple MacIntosh TM plus/SE/II, DEC Q-Bus and UNIBUS, VMEbus, MULTIBUS, S-100Bus, STD bus and SBX BUS. Allan Crawford Associates.

Circle No. 26 on Reader Service Card

GP-Series Scope



GW Instruments offers six general-purpose scopes for the educational, industrial and Radio/TV/VCR servicing markets. The range varies from 5MHz single-channel (the GOS935) to the dual- trace 40MHz (GOS543). A warranty extension to two years can be purchased at the same time. Duncan Instruments.

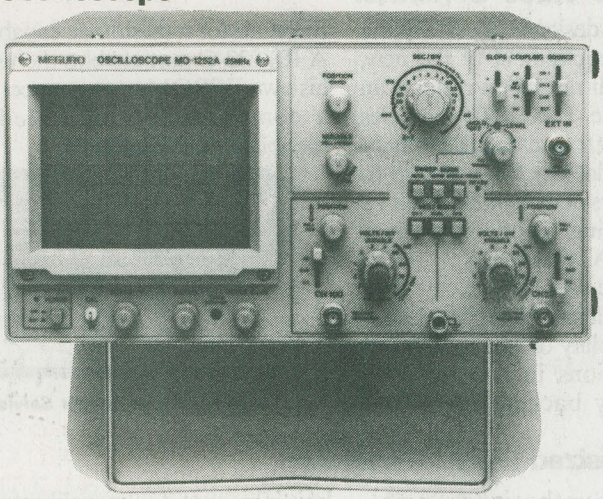
Circle No. 27 on Reader Service Card

Immersion Thermistor Housings

"Standard" Thermistor Immersion Housings is one of the 3 major sensing applications sections featured in the Free 28 page "Standard" Thermistor Housing Catalog now being offered by Fenwal Electronics/APD. The catalog provides a Thermistor Sensor vs Thermistor Housing compatibility table that quickly allows the reader to determine which "Standard" Thermistor sensor is compatible with which "Standard" Thermistor Housing(s). In addition, the catalog is data filled with comprehensive technical copy, charts, graphs, etc. The "Standard" Immersion Housings listed offer the potential user high quality, high tech units that are low cost and readily available for fast delivery. Fenwal Electronics.

Circle No. 28 on Reader Service Card

25MHz Oscilloscope



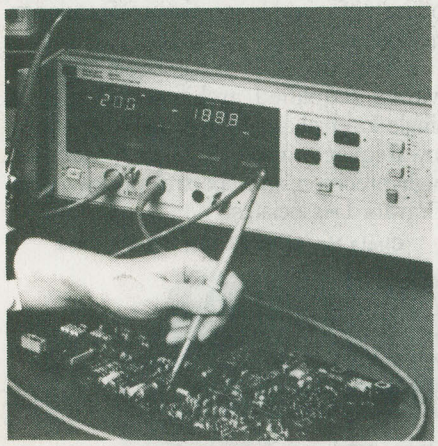
The MEGURO MO-1252A dual trace, 25MHz bandwidth oscilloscope. It features 5mV to 5V/division sensitivity, x 5 magnification and X- Y operation. The MO-1252A measures up to 400Vp-p with horizontal sweep time from 0.2 us to 0.5 s/division. RCC Electronics.

Circle No. 38 on Reader Service Card

ESD Strap Tester

The Model 250 Wrist Strap Tester is an inexpensive, compact automatic portable or bench top test unit which checks the specified resistance limits of all types of wrist straps and other similar personnel grounding devices. Features include other similar personnel grounding devices. Features include both visual and audible indicators plus a unique fail-safe design with automatic self-check.

The tester automatically measures the resistance of the wrist strap and compares the measurement to pre-set lower (750 Kohms) and upper (1.25 or 10 Megohms) resistance limits. A two-position switch located on the front panel enables the user to select either a 10 Megohm upper limit for checking the condition of the wrist strap while on the wearer's wrist or a 1.25 Megohm upper limit for checking the wrist strap alone. Other limit values are available as an option. Electro-Tech Systems.



RF Vector Voltmeter

A new vector voltmeter designed for sensitive rf voltage and phase measurement has been introduced by HP. For simple manual testing or use in automatic test systems, the HP 8508A offers a low-priced solution for instruments in the 100-kHz to 1-GHz or 300-kHz to 2-GHz frequency range. Some of its many applications include: an rf millivoltmeter for measuring low-level signals, in-circuit probe to align gain and phase response or for troubleshooting, characterizing circuit s,y, or z parameters; and use as a building block in ATE systems. Hewlett-Packard.

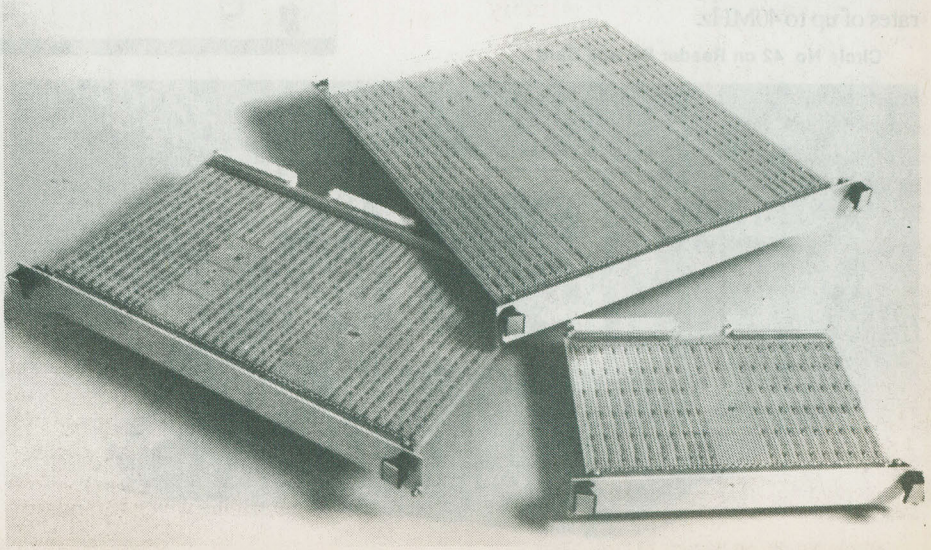
Circle No. 39 on Reader Service Card

Circle No. 41 on Reader Service Card

Wire Wrap Panels

A new series of 4-layer wire-wrap panels now supports Augat Inc's VME/DIN product line. This new series of wire-wrap panels combines a 4-layer construction with surface mounted decoupling capacitors to meet the performance demands of today's high speed logic, while increasing component density by over 400%. VMEbus or uncommitted DIN panels are available in 6 DIN sizes of double and triple height with depths ranging from 160mm to 400mm. The high density pin pattern allows 0.3" and 0.6" DIP packages to be placed anywhere on the panel and includes a wide pin grid array pattern extending the full depth of the panel. Augat Inc.

Circle No. 40 on Reader Service Card



Logic Monitor

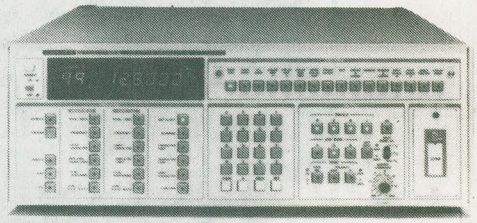
American Reliance today announced an advance new addition to their logic measurement product line, the AR-80LM Logic Monitor. The custom-IC design provides autodetection of both power and ground pins, making instrument usage an easy, clip-on-and- view operation. Additionally, the unit also autodetects both TTL and CMOS logic levels.

The unit provides indications for logic high, low. and even pulsing inputs. For pulses with repetition rates over eight hertz, the unit flashes the LED at an 80Hz rate. This allows use of the unit at clock rates of up to 40MHz.

Circle No. 42 on Reader Service Card

Programmable Video Generator

The LVG-1604 is designed to satisfy the signal generator requirement of the new, most advanced high resolution raster scan CRT displays. The LVG-1604 provides the user test patterns can be easily generated with a dot clock rate of up to 131MHz and rasters of up to 4096 pixels by 4096 lines depicting standard or user defined. patterns. A wide range of special functions allows the user to have complete control over the unit's activities.The LVG-1604 has the capability of storing 100 sets of display conditions in two separate mediums; battery backed RAM and EPROM for total storage capability of 200. A RS-232-C port enables the user to burn his own EPROM or to connect the unit to a computer for unlimited storage capability. Omnitronix.



Circle No. 43 on Reader Service Card

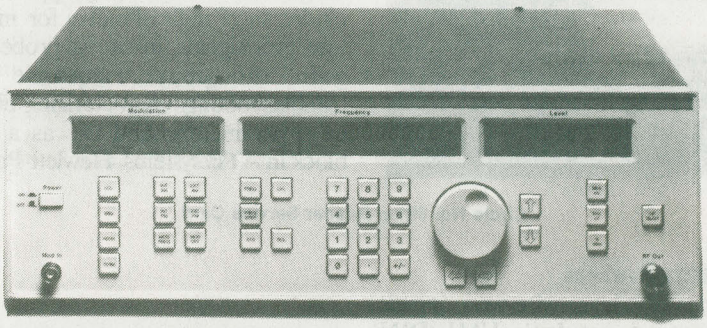
2 GHz Synthesized Signal Generator

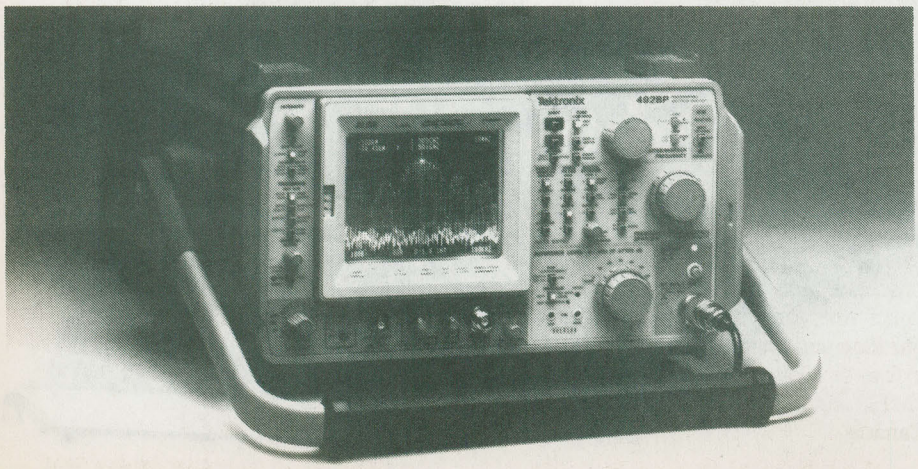
A new 2 GHz Synthesized Signal Generator with -137 to +13 dBm output power and standard frequency accuracy of 0.00025% is now available from Wavetek. This signal generator has been engineered to be extremely easy to use with features like: front panel spin knob, keyboard, curser keys, and large, easy-to-read backlit LED displays. Sixty-four complete front panel set up can be stored in non-volatile RAM for sequential or random recall. Programming can be done via the front panel or the optional GPIB bus.

The Wavetek Model 2520 features self diagnostics and AutoCal. AutoCal allows the unit to be calibrated on site through a machine prompted procedure in approximately 15 minutes for frequency, FM deviation and output levels. The level calibration can be made at the RF output or at the device under test to compensate for cable or fixture frequency response.

The Model 2520 has been designed with a simplified architecture, using a single-loop phase lock technology and a low frequency direct digital synthesizer for high precision and spectral purity. Allan Crawford Associates.

Circle No. 44 on Reader Service Card





Microwave Spectrum Analyzers

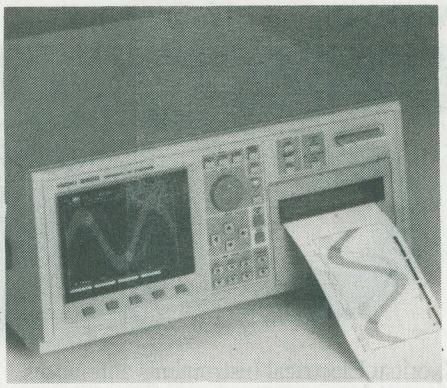
Tektronix announces that four models of their current microwave

Spectrum Analyzers now offer expanded capability, providing premium performance and measurement capability. The 492B and 493BP (programmable) portable Spectrum Analyzers and the 2755A and 2755AP (programmable) laboratory Spectrum Analyzers now include as standard many additional features, such as a microwave frequency counter, 1PPM accuracy, external reference lock and more. Tektronix Canada.

Circle No. 45 on Reader Service Card

Waveform Recorder

The Hioki 8850 HI-Corder is designed to meet the demands for higher speed recording and waveform analysis. It features powerful trigger functions and a built-in graphics editor. Data storage is accomplished with a full 64K word per channel and external IC memory cards. A large 7 inch CRT provides the user with simple menu commands for ease of operation. Finally a CPIB port for full remote control is standard equipment on the 8850. RCC Electronics.



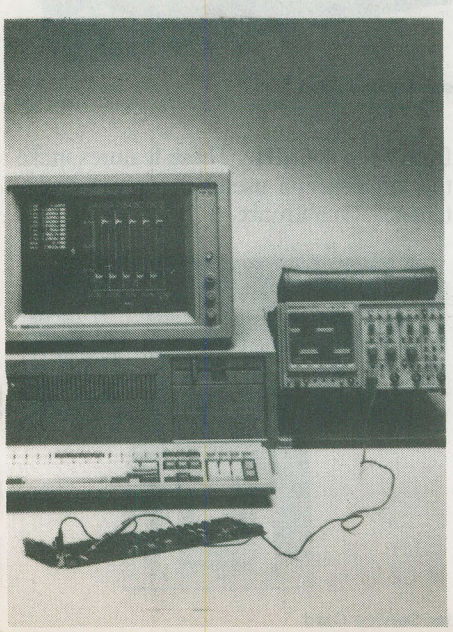
Circle No. 46 on Reader Service Card

Ultrasonic Generator

The proSONIK generator is claimed to be the first digitally controlled ultrasonic cleaning system. The generator, part of a complete cleaning system, allows users to create their own proprietary cleaning procedures for manufacturing and research purposes.

proSONIK generators are the first to control the five physical characteristics of an ultrasonic process. They regulate the energy of cavitation implosions; cavitation density as a function of tank volume, time, and position in tank; and gaseous phase concentration. The digital technology allows users to match wave characteristics precisely to the ultrasonic job at hand. J.M. Ney Company.

Circle No. 47 on Reader Service Card



GPIB Controller

Tektronix announces a new systems controller that adds a key element to its line of GPIB test and measurement instrument integration products and services. The PEP 301 is designed for GPIB systems and the MS-DOS tm software environment. It is based on the Intel 80386 processor and 80387 coprocessor. The PEP 301 package includes a high resolution color graphics card, a color monitor, a duel voltage system unit, GPIB interface and application software.

The PEP 301's 16MHz Intel 80386 processor and 80387 coprocessor assure faster operation for demanding data acquisition and analysis applications. It is two to four times faster than the popular 16-bit, 8MHz 80286-based systems. Tektronix Canada.

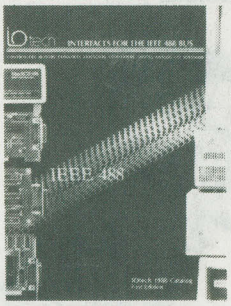
Circle No. 48 on Reader Service Card

IEEE-488 Catalog

IOtech has published its 1988 product catalog, detailing its expanded line of IEEE-488 bus interfaces for IBM and compatible personal computers, and Apple Macintosh personal computers.

Twenty-four new hardware and software products are described in the catalog. New products include a wide selection of Macintosh interfaces for instrument and plotter control, RS-232/IEEE bus converters, a digital input/output IEEE interface, serial IEEE bus converters, and several interface products for use by OEMs.

The catalog also contains a technical review of the IEEE bus. IOtech Inc.

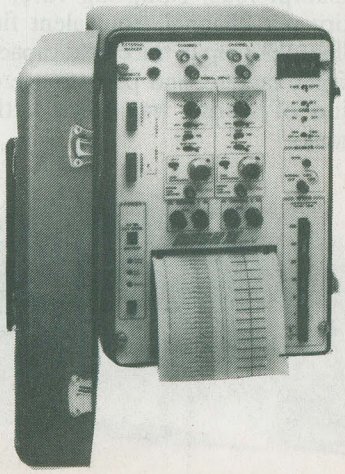


Circle No. 49 on Reader Service Card

2-Channel Field Recorder

The Dash II model MT offers features such as frequency response to 500 Hz full-scale, separate or overlapping channels, and a complete chart record including printed text. It produces sharp tracings on low cost thermal paper.

Based on Astro-Med's New Technology, the Dash II operates without pens or pen motors. Only the chart paper moves. As a result, the recorder is reliable and accurate under the most brutal field conditions: shock and vibration, heat and cold, and cruel chemical atmospheres.



Circle No. 50 on Reader Service Card

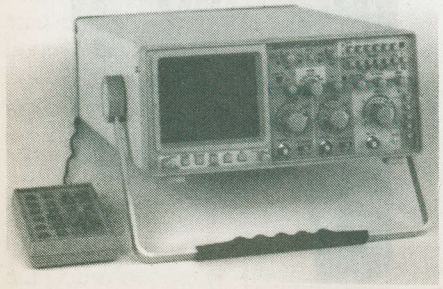
Versatile DMM

B&K-Precision has combined the capabilities of five popular instruments into one hand-held Test Bench tm unit. This 41-range voltmeter ammeter, ohmmeter, frequency counter, capacitance meter, logic probe, transistor Hfe and diode tester features an extra-large LCD display, ruggedized case and B&K -Precision quality. Model 388-HD features: 3-1/2 digit display, 0.5% DCV accuracy, resistance of 0.1 ohms to 2000 Megohms, overload protection (200mV range) of 500 VDC or 350 VAC rms max., 20 Amp range and excellent frequency and capacitance measurement. Atlas Electronics.

Circle No. 51 on Reader Service Card

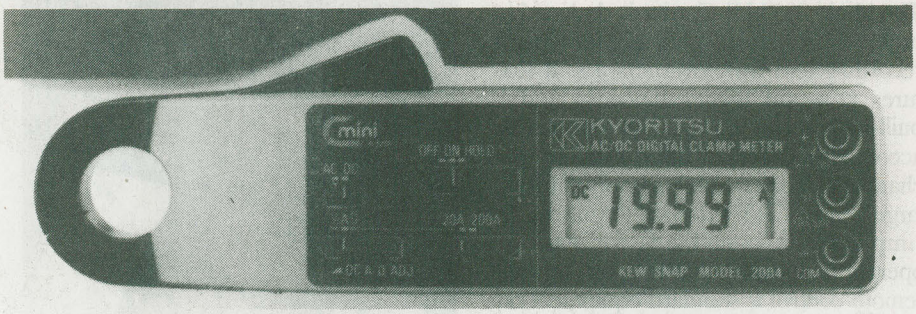
Digital Storage/Analog Oscilloscope

B&K-Precision has just added a new digital storage/analog oscilloscope to its product line – Model 2521. Features include 20MHz realtime and storage bandwidth, cursor control with CRT readouts, RS-423 interface, automatic time and voltage measurement, megasample/sec. sampling rate, 1k memory per channel, equivalent time sampling, plot output, trace hold capacity, pre-trigger capture, and post storage expansion of stored waveform. Atlas Electronics.



Circle No. 52 on Reader Service Card

AC/DC Digital Clamp Meter



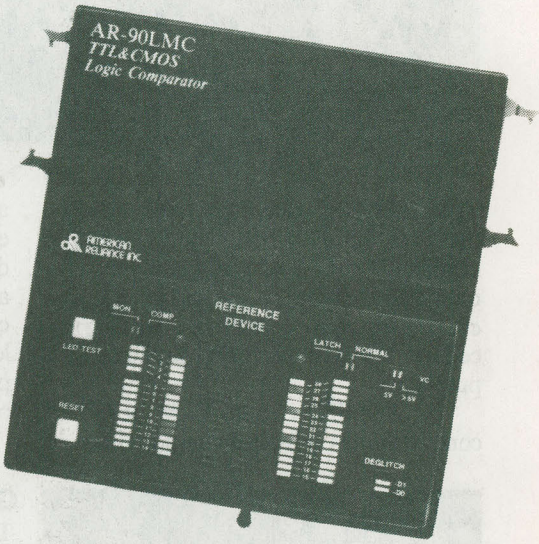
Kyoritsu Electrical Instruments announces a new digital clamp meter for AC/DC measurements. The model 2004 clamp meter is lightweight (170G battery included) with large LCD display. Features include AC/DC current measurement up to 200A and 10mA resolution on the 20A scale. Voltage measurements to 200 VDC are also possible. Housed in a fire retardent plastic material with a data hold feature, the Kyoritsu 2004 is designed for measurements in crowded switch boxes, cable areas, computer power supply installation and automotive electrical systems that cannot be reach with larger sized clamp meters. Omnitronix.

Circle No. 53 on Reader Service Card

Logic Comparison Tester

American Reliance announces their new Logic Comparator, the AR-90LMC. Based on a proprietary custom IC that allows use of a single model with both TTL and CMOS logic, the unit far outperforms other units presently available. It features two modes of comparison, normal or latch, and allows direct viewing of logic states by using the built-in monitor mode.

The unique design allows the unit to operate at 20MHz, and to detect a single timing error as short as 50nS, which are two and three times faster than the nearest competitor, respectively. The unit also tests ICs of up to 28 pins, versus the competition's maximum of 20 pins, thereby further enhancing already outstanding value and performance. BCS Electronics.

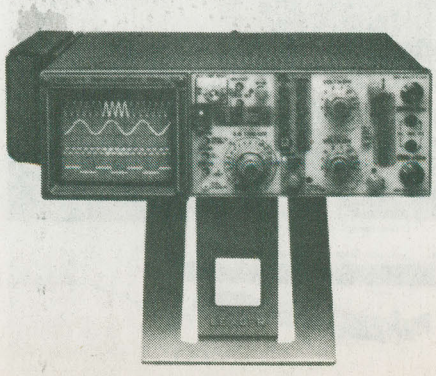


Circle No. 54 on Reader Service Card

Battery Oscilloscope

The Leader model LBO-315 is the smallest, full featured,

60MHz,AC/DC unit available today. LBO-315 fits in a 3 inch deep attache case, allowing a field service engineer the ability to service equipment under the most constraining field conditions. Weighing only 10 pounds including battery, with a compact size of 3x9x11 3/8 inches,the unit will operate from a supplied, self contained 12V battery, with a built-in battery charger which has a tining circuit to prevent overcharging. In addition the LBO- 315 can be operated from external power sources of 10 to 20 volts DC or 85 to 264 Volts AC (no external switching) and line frequency from 50 to 400MHz. These features make this oscilloscope useful in aircraft maintenance. Omnitronix.



Circle No. 55 on Reader Service Card

Envelope Shaper

Keyboard players and guitarists are sure to make a big impact with this low cost sound effects box.

RUSSEL G. PAYNE

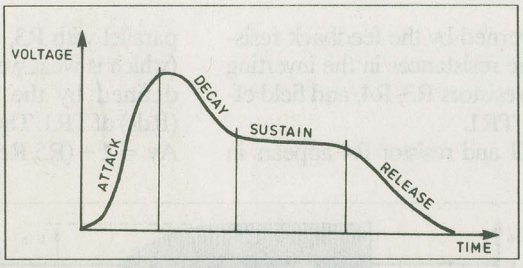


Fig. 1. A generalized sound waveform envelope showing the four controlled periods used in the synthesis of sound.

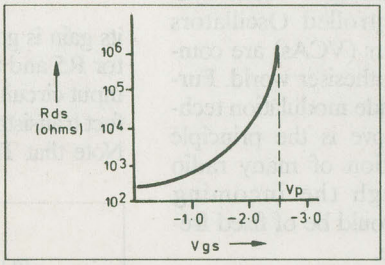


Fig. 2. How the drain-source of an n-channel FET varies with gate voltage.

Although there are a large amount of devices on the market to enhance (or disguise) the guitarist/keyboard players' sound, the author has not come across this device in stores – at least not in such a simple and inexpensive form as this one. The effect produced is best described as that obtained by playing a tape backwards – the natural "envelope" (or waveform profiles) are all reversed.

A guitar, for example, with its natural short sound rise time and long fall time would sound more like a violin, with its long attack time. Some players produce this effect simply by winding the volume control up and down.

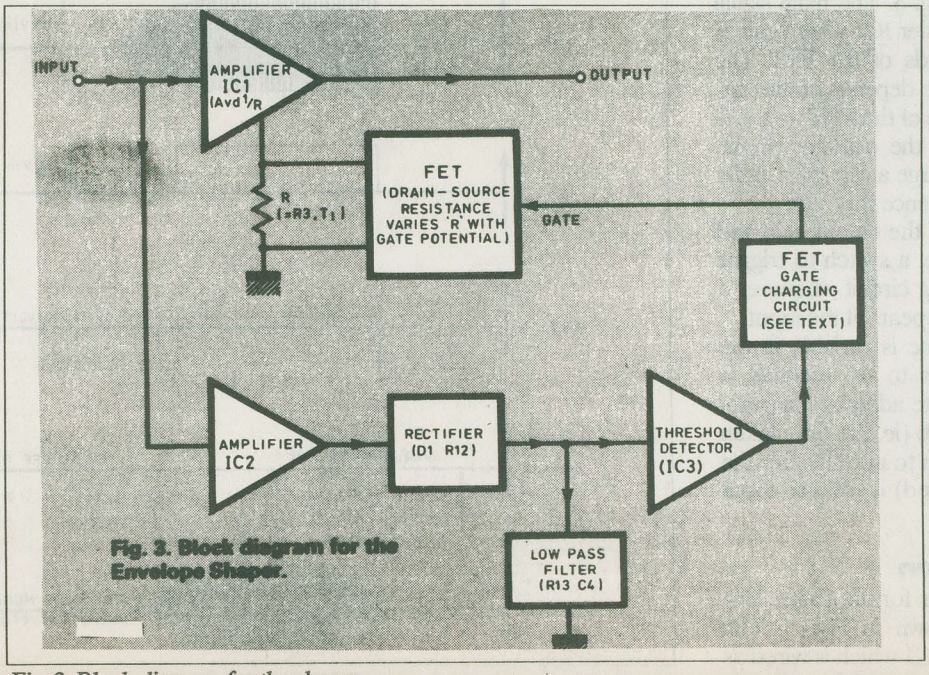


Fig. 3. Block diagram for the Envelope Shaper.

Fig. 3. Block diagram for the shaper.

Envelope Shaping

Envelope shaping, as this technique is called, has been around for a long time: commercial envelope shapers giving control over attack, decay, sustain and release times (see Fig. 1), are available but are inevitably expensive and often over-complex. The circuit, which generates the "reverse attack" effect can be considered to be a simple form of envelope shaping; in the terms of Fig. 1, the attack time is variable; the release time is a fixed short period and the sustain and decay periods follow the input waveform envelope.

There are easier ways to produce this effect without actually tape-recording the sounds and reversing

them, or wearing out your volume control. This project employs an op amp whose gain is varied to amplitude-modulate the incoming waveform.

Op amps are convenient to use here, because their gain can be changed by varying either the feedback or the source resistor. In this circuit, a field effect transistor (FET) is used as a variable resistor inserted as one of the gain defining resistors in the op amp circuit. By changing the Gate-Source Voltage (Vgs) the effective Drain-Source Resistance (Rds) is also changed.

A graph of Vgs against Rds to illustrate this effect is shown in Fig. 2. When Vgs exceeds a value known as the "pinch-off" voltage (VP), the FET becomes cut-off and Rds is virtually open-circuit. The minimum Rds value, when Vgs = 0 however, is less well defined and depends on the FET manufacturing process; the exact value is not critical in this circuit.

To digress a little, the idea of using DC levels to control sound in this way is actually the basis of analogue sound synthesis. Voltage Controlled Oscillators (VCOs) and amplifiers (VCAs) are common jargon in the synthesiser world. Furthermore, the amplitude modulation technique mentioned above is the principle used in the generation of many radio wavebands although the incoming waveform (carrier) would be of fixed frequency and amplitude.

How it Works

A block diagram of the Envelope Shaper circuit is shown in Fig. 3. The main signal path is through amplifier IC1 whose gain is dependent on the Rds of the FET The overall "attack" profile depends on the signal applied to the gate of the FET – a DC voltage derived from the detector circuit. IC2/IC3 is used to charge a capacitor in the FET gate circuit and hence vary Vgs.

The lower half of the circuit, IC2 and IC3 forms, in essence, a switch to trigger the FET gate charging circuit whenever a large enough signal appears at the input.

The charging time is variable in the range 22 milliseconds to 0.6 seconds, a range found to be quite adequate in practice. The recovery time (ie, the time taken for IC1's gain to return to normal after the input signal has decayed) is fixed at about 15 milliseconds.

Circuit Description

The full circuit diagram for the Guitar Envelope Shaper is shown in Fig. 4. The heart of the circuit is IC1 which is wired as a non-inverting voltage amplifier. Clearly its gain is governed by the feedback resistor R5 and the resistances in the inverting input circuit, resistors R3, R4, and field effect transistor TR1.

Note that TR1 and resistor R4 appears in parallel with R3, so the overall gain of IC1 (which is what we wish to control), is really defined by the drain-source resistance (Rds) of TR1. The gain of IC1 is therefore:

Av = 1 + (R5/Req)

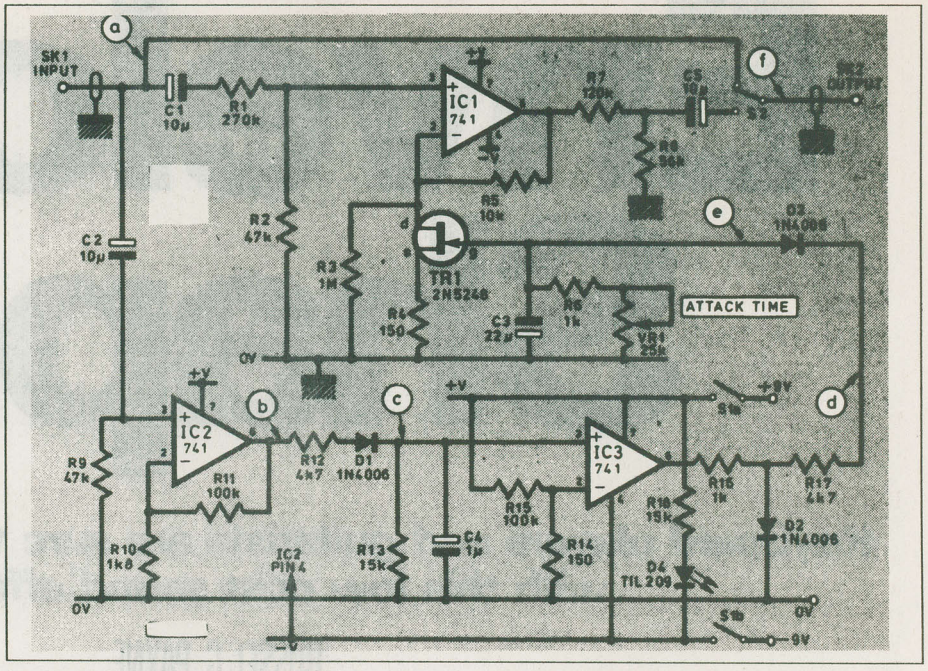


Fig. 4. The complete circuit diagram. The letters inside circles refer to waveforms shown in

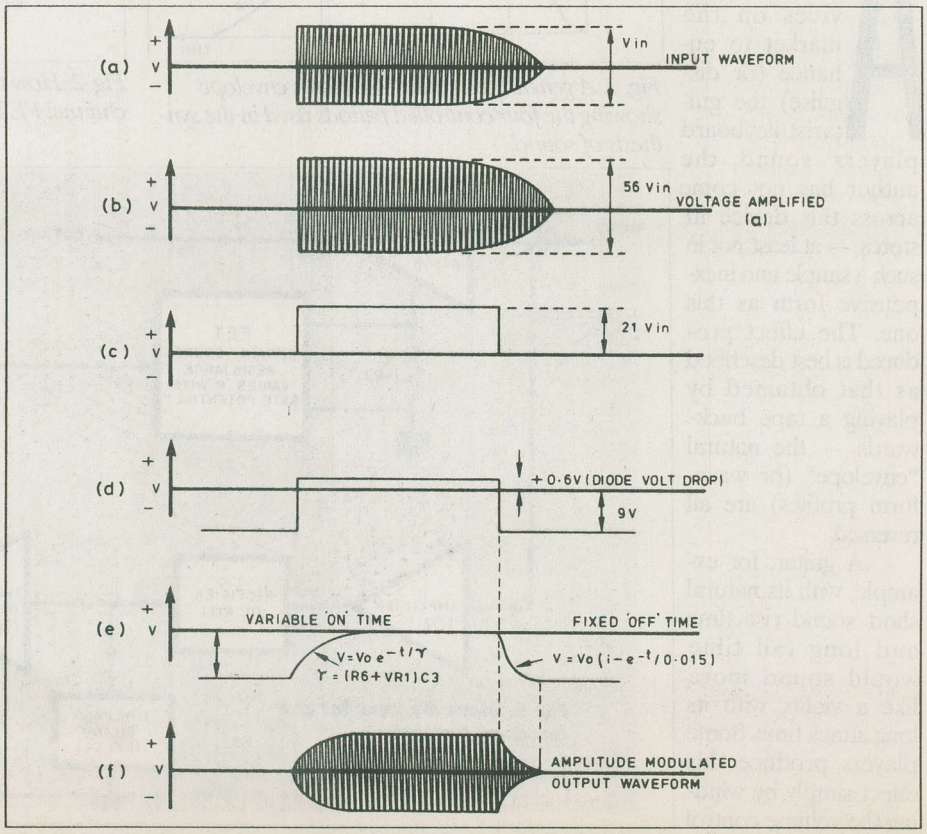
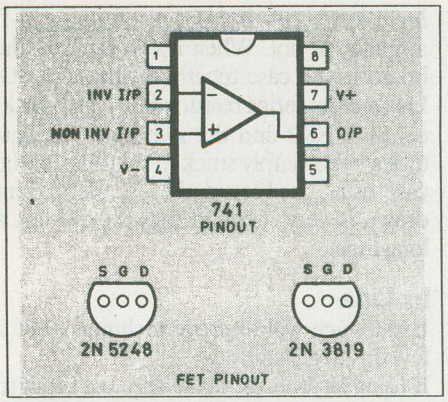


Fig. 5. Typical waveforms at various points in the circuit diagram.



Pinout details for the FET and IC.

where Req is the combined resistance of R3/(Rds+R4).

When an input signal is applied — say from an electric guitar — we require IC1's gain initially low. It can't go to zero, but by ensuring that resistor R5 is a lot less than Req(max) we can make it near enough unity.

Given that Rds(max) is near enough infinity, and Rds(min) is of the order of 500 Ohms, we find:

Req(max) = 1M

Req(min) = 650

Hence, IC1's gains are: Av(max) = 16

Av(min) = 1

A diagram showing voltage waveforms at various points in the circuit should be useful at this stage and is shown in Fig. 5. To vary IC1's gain we need firstly to detect the presence of an input signal. IC2 is another non-inverting voltage amplifier with a fixed gain of 57 simply to boost the signal level.

The output is half-wave rectified by diode D1, and smoothed (or low-pass filtered) by C4/R13 to produce a positive DC level proportional to the input waveform amplitude. IC3 is wired as a comparator with a triggering level (set by the voltage divider resistors R14/R15) of about 14mV to prevent the circuit from triggering on noise, etc. from IC2. When the signal level in pin 3 of IC3 exceeds 15mV the output flips up from -9V to +9V

The positive outputs are dumped to ground through R16/D2 so that the FET gate charging circuit sees a rising square edge from -9V to +0.06V. The FET gate potential rises towards 0V at a rate defined by capacitor C3 and (resistor R6+potentiometer VR1). Note that the charging waveform due to capacitor C3 is always exponential — it's only the charging time that is changed by varying the setting of VR1.

Finally, you'll notice an attenuator at the output (pin 6) of IC1. This is necessary to trim the overall gain of the system to suit

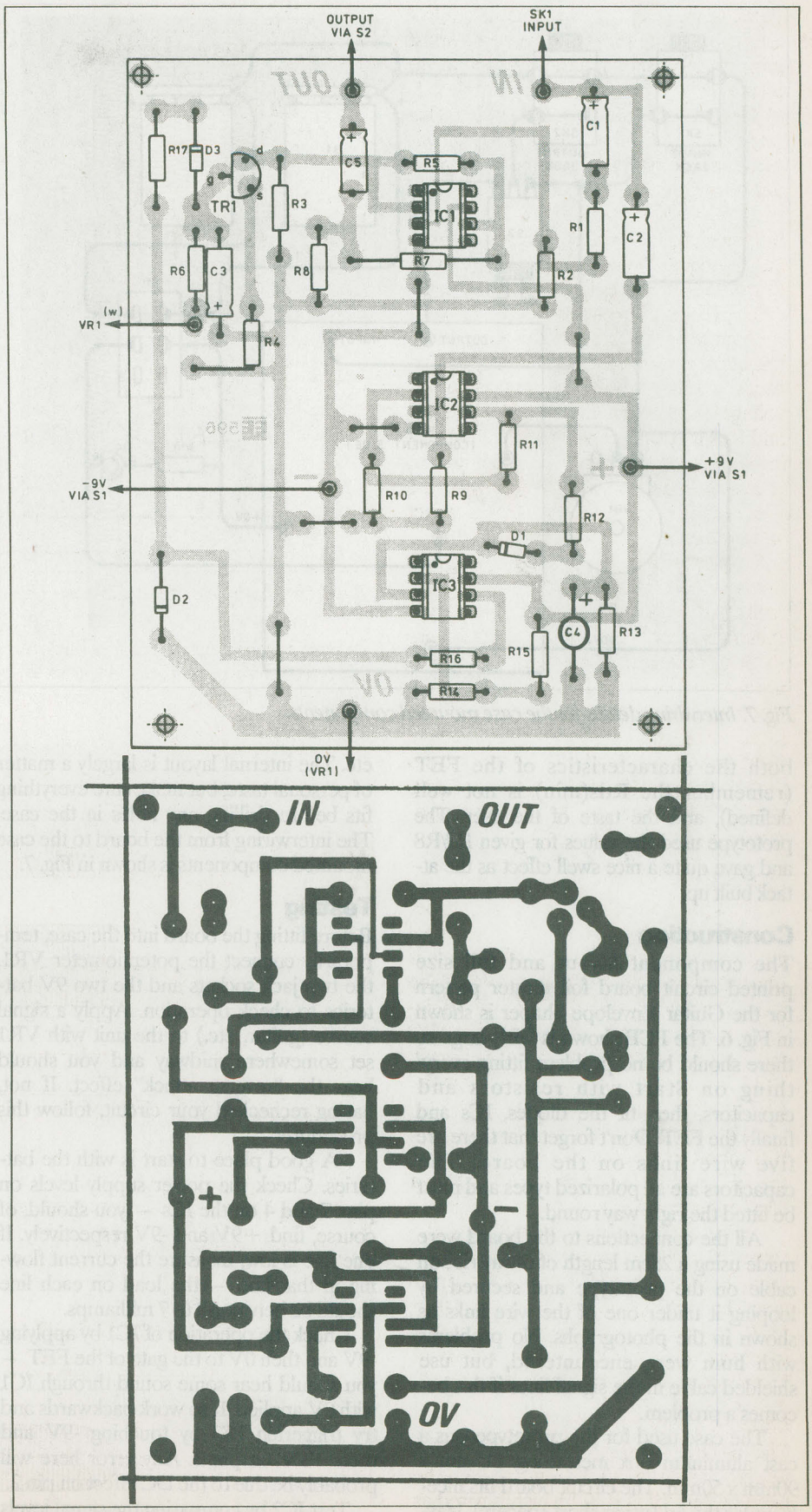


Fig. 6. The full size printed circuit board and component layout.

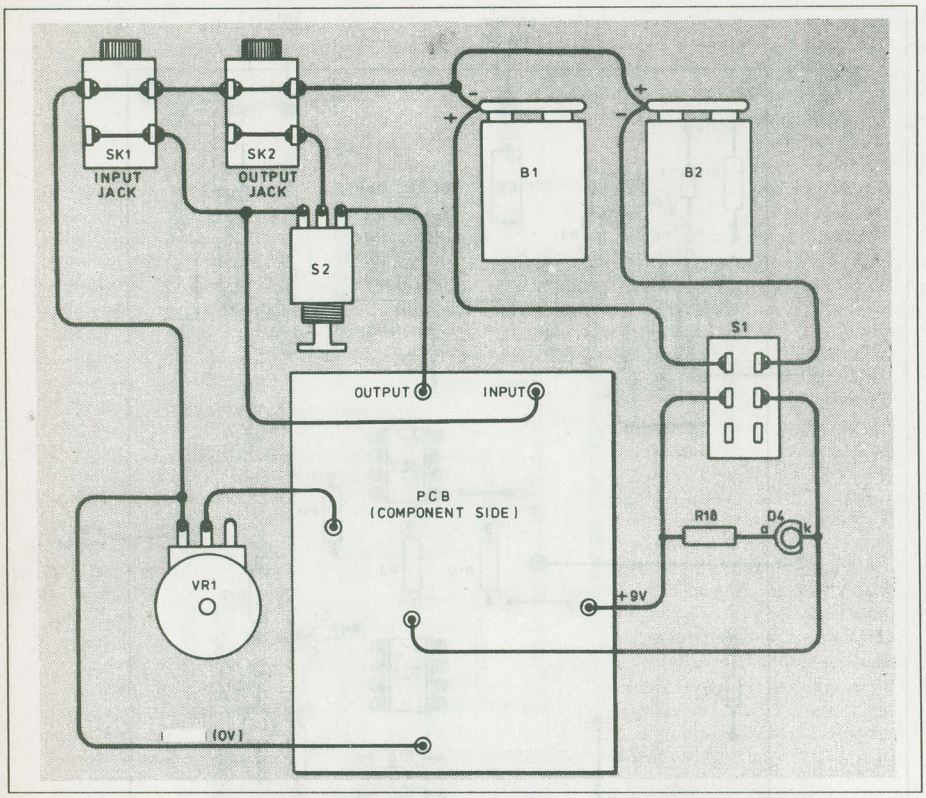


Fig. 7. Interwiring details for the case mounted components.

both the characteristics of the FET (remember the Rds(min) is not well defined), and the taste of the user. The prototype used the values for given R7/R8 and gave quite a nice swell effect as the attack built up.

Construction

The component layout and full size printed circuit board foil master pattern for the Guitar Envelope Shaper is shown in Fig. 6. The PCB shown is fairly large so there should be no problem fitting everything on Start with resistors and capacitors, then fit the diodes, ICs and finally the FET. Don't forget that there are five wire links on the board. The capacitors are all polarized types and must be fitted the right way round.

All the connections to the board were made using a 28cm length of 6-way ribbon cable on the prototype and secured by looping it under one of the wire links as shown in the photographs. No problems with hum were encountered, but use shielded cable in the signal lines if this becomes a problem.

The case used for the prototype was a cast aluminum box measuring 115mm x 90mm x 50mm. The circuit board fits nicely under the lid (using short spacers), leaving the box free for the batteries, switches, etc. The internal layout is largely a matter of personal taste, but make sure everything fits before drilling any holes in the case. The interwiring from the board to the case mounted components is shown in Fig. 7.

Testing

Before fitting the board into the case, temporarily connect the potentiometer VR1, the two jack sockets and the two 9V batteries to check operation. Apply a signal source (guitar, etc.) to the unit with VR1 set somewhere midway and you should hear the "reverse attack" effect. If not, having rechecked your circuit, follow this procedure:

A good place to start is with the batteries. Check the power supply levels on pins 7 and 4 on the ICs – you should, of course, find +9V and -9V respectively. If one line is low, measure the current flowing in that line – the load on each line should be between 3 to 7 milliamps.

Check the operation of IC1 by applying -9V and then 0V to the gate of the FET – you should hear some sound through IC1 with 0V applied. If so work backwards and try triggering IC3 by touching -9V and then +9V on pin 3. Any error here will probably be due to the DC effect on pin 2.

Test IC2 by comparing the signal levels at pins 3 and 6 using either a 'scope if you have one, or the input of your hi-fi amplifier if not. When it's working fit the board in the case together with the LED. D4 (and its series resistor R18), jack sockets SK1, SK2 and the switches. The batteries were simply stuck to the sides of the case using double-sided tape; the current drawn is very low and they should last a long time.

In Use

Experience will improve technique, but a few tips to get started:

If using keyboards, make sure the input to the unit is not so large that it triggers on keyboard output noise.

With guitars, the opposite is generally true – keep the pickup volumes wound up or you won't get much sustain. This is particularly true of the higher notes. Connecting this unit after your amplifier preamp may help here.

Finally, don't overdo it with this device. All sound effects become boring if they're constantly in use, so only switch it on when it's needed. ■

PARTS LIST

Resistors

R1	270k
R2, R9	47k
R3	1M
R4, R1	4 150
R5	10k
R6, R16	1k
R7	120k
R8	56k
R10	1k8
R11, R15	100k
R12, R17	4k7
R13, R18	15k

All 1/8W 5% carbon

Potentiometer

VR 1 25k carbon lin.

Capacitors

C1, C2, C5	1 0u elec. 40V
C3	22u elec. 40V
C4	1u tant. bead, 35V

Semiconductors

D1,D2, D3	1N4006
D4	Red LED.

TR1 2N3819 n-channel FET (or similar)
IC1, IC2, IC3 741 op amp

Miscellaneous

S1 2-pole miniature slider switch
S2 Single-pole push button changeover switch (push-on push-off)
SK1, SK2 Standard 1/4in. jack socket
PCB, aluminum boxapprox. 115mm x 90mm x 50mm; 9V batteries and connectors; connecting wire; solder; nuts, screws, etc.

SPECIAL SUPPLEMENT

386 BUYER'S GUIDE

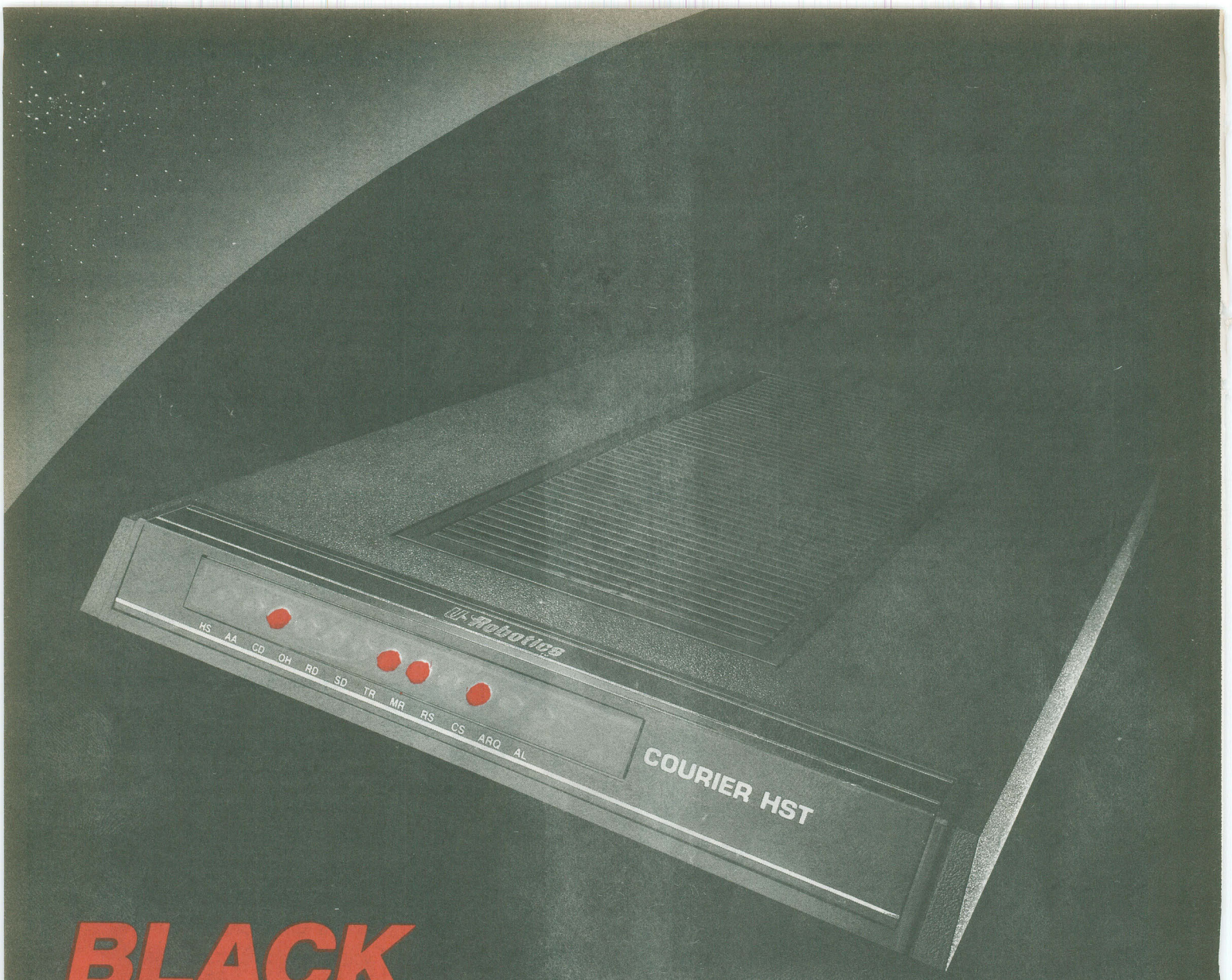
The state of the art is a nebulous thing... and no more so than when one is dealing with microcomputers. We've all experienced the sinking feeling of discovering that hardware which was poised on the leading edge when it was bought is suddenly antediluvian.

The 80386 based computers which have emerged over the past year or so are unquestionably the next generation of PC hardware. Upward compatible with the software of previous generations of PCs, they offer blinding speed, huge memory capacities and all manner of internal hardware tricks. They're amazingly sophisticated, and every bit as confusing.

In producing the 386 buyer's guide, we have tried to assemble a collection of short reviews of the popular 80386 based systems to serve as the groundwork for someone looking for a state of the art computer. Unless your requirements are very modest, you probably won't find *everything* you'll need to know about the machine you're considering herein. However, When you get to the last page of this section you should have a much clearer idea of what specific questions you want answered next.

The power of the 80386 based machines is that they can be much more personal, much more in keeping with your specific demands of a microcomputer. The drawback to this, of course, is that you will have to do a great deal of investigation to find the system that best suits you.

If you're reading this, you've probably outgrown the capacity of your present system, and are looking for the next generation of micros. Welcome to the world of the 386.



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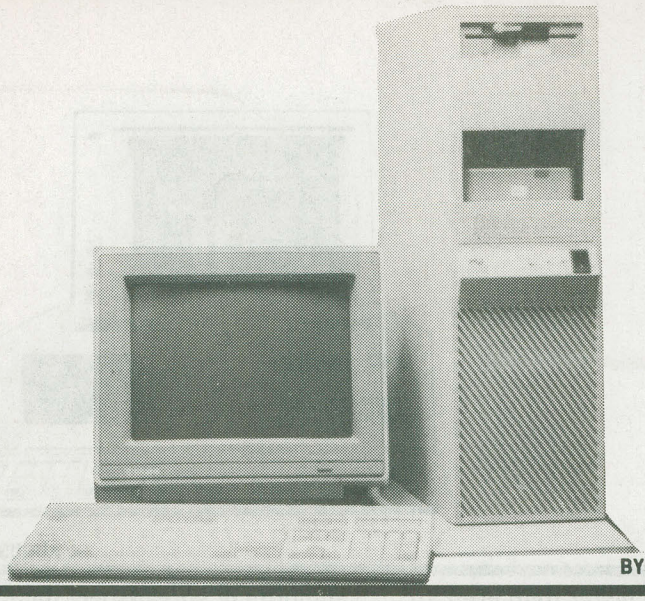
INTEL TOWER



BY MORRIS JAMES

The Intel Tower System, from EMJ Data Systems, is nothing if not standardized. The machine is built around the genuine Intel 80386 motherboard, and if Intel doesn't know how to build an 80386 computer then who does? Certainly the Tower inspires a bit more confidence than the product of your average Taiwanese basement clone shop.

As the name implies, the Tower is set up in a vertical, floor standing configuration. This is great for impressing your office underlings, and it even saves some desk space.

Overall, theTower System turns out to be a rock-solid piece of equipment. With relatively sedate sixteen megahertz speed, it still performs the pants off your garden variety AT. The configuration we got for review had a few other things going for it as well, which I'll come to in due course.

BROAD CASTERS

The Tower was certainly superlative in at least one way. It arrived in by far the largest box of any of the 80386 systems we looked at. Envision something like a white corrugated- cardboard coffin.

There was a daunting collection of tiny screws, brackets and plates rattling around in the bottom of this box. Fortunately, it turned out that assembly consisted mainly of mounting the base plate on the machine's tower style case, and snapping a decorative plastic cover panel on its back. With these accoutrements in place, the Tower did just that... it towered vertically, just like the high-numbered IBM PS/2 Models that have popularized this configuration. The base plate had four mysterious sets of holes in its corners, which I eventually concluded could accept a set of *casters*... presumably in case you want portable computing, but don't plan to leave level ground.

The Tower came with what has to be my all time favorite keyboard, the Maxiswitch. Maxiswitch units typically feature lightweight, soft-plastic keycaps that I find very pleasant on my fingertips, and a positive but featherlight feel that lets me touch type at ridiculous spds... excuse me, I mean speeds. The Maxiswitch is also very accommodating of different keyboard standards. The one that accompanied the Tower had a DIP switch to set up for XT or AT operation, and another to allow reversal of that execrable IBM standard control key misplacment. The layout was otherwise PS/2 standard, with function keys at the top, and an extra pad of cursor controls. This is not my favorite arrangement, but it can be lived with once the control key problem is solved.

Typical of the Intel systems, the Tower came configured with only 512K of DOS RAM, plus about 2 megabytes of extended memory. A half megabyte of working memory is hardly enough these days. However, EMJ had the situation in hand, in that the kit included Quarterdeck's QEMM 386 memory management software... highly similar to the 386^{Max} program we'd been using in testing most of the other 80386 machines. Both 386^{Max} and QEMM can use advanced 80386 modes to remap extended memory so as to backfill your DOS space up to the theoretical maximum... something over seven hundred kilobytes, depending on your video installation. Like 386^{Max}, QEMM also provides EMS expanded memory emulation, allowing extended AT type memory act like the dedicated EMS RAM boards. This is extremely handy for a variety of applications, ranging from large spreadsheets to Microsoft Windows.

BIOS was courtesy of Phoenix, and seemed to handle everything with its usual aplomb.

DANGEROUS DRIVING

The Tower included a Priam hard drive, which proved a bit of a pig to install... for the annoyingly simple reason that its files could not be copied onto a single, bootable floppy disk as required by the written instructions. There wasn't room on the disk. I can't explain this, except that possibly the installation routine was built around an earlier, more compact version of DOS. I was using 3.2.

I eventually got around the problem by dint of much swapping between the original Priam utility disk and my DOS master.

The Priam vindicated itself greatly, however, by posting the all but unbelievable Norton rating of 3.9... and this with a relatively conservative measured interleave value of 2. With a disk cache installed, data retrieval on this brute should happen just a bit before you ask for it.

The Norton system SI test was less enthusiastic, measuring a relaxed... but respectable... 16.6. Our Computing Now! sieve returned 104, which compares to 1074 for a stock PC.

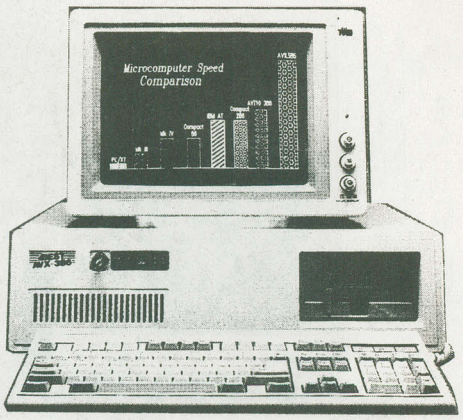
The Tower was equipped with a "LEGA" video card, which exhibited rather lethargic performance... several times slower than the usual EGA. However, this card proved highly susceptible to the public domain ZENO screen speedup utility, so much so that screen performance jumped to within a stone's throw of the fastest video we'd seen, that of the PS/2 Model 70! Although the Tatung monitor that came with the Tower wouldn't allow it, the LEGA is capable of emulating all sorts of things, and of providing up to 640 by 480 resolution to things like AutoCAD and Windows.

TOWERING INFERNO

Overall, the Tower System is a good looking package. If I were mixing and matching, I'd forego the LEGA card, but insist on the Maxiswitch keyboard and the Priam drive... cranky installation procedure and all. The Intel board itself performed admirably, and would no doubt be a safe long-term choice.

Intel Tower System: Price not available at press time. Contact EMJ Data Systems Ltd, P.O. Box 1012, Guelph, Ont N1H 6J3, phone (416)454- 2940.

BEST AVX-386



BY AUGUST WEST

The AVX-386 looks a lot like the 80286 based AT compatible which Best released a few years ago. It's fairly large as machines go at the moment, but this is partially due to its having a really massive power supply under the hood and a nice substantial case. Under these circumstances, of course, most sensible users will live with a few extra square inches of desktop hidden below the metal.

The machine I got to review came with two floppies... one dual density three hundred and sixty kilobyte drive and one of those quad density drives that hold one and a bit megabytes. There was also a really fast hard drive in there, which I considered unbolting and making off with. While I haven't yet found a meaningful benchmark for comparing drive speeds, intuitively it seemed to be quite a bit faster than the one in the company AT.

The motherboard for the AVX-386 is a bit unusual. It's probably the most densely populated 386 motherboard I've yet encountered. The machine seems to be almost entirely done with small scale integration, using only those LSI chips as are essential to the design of an AT compatible. It's sort of a brute force approach to computer design. Once again, this is by no means a bad thing. Presumably based on a traditional AT, it's a safe, proven design which isn't likely to do anything untoward in the future.

An interesting feature of the AVX-386 is that it has another huge assortment of chips on a peripheral card. Called the I/O channel card by the manual, this thing holds the clock, the keyboard interface and the parallel and serial port hardware, although the actual connectors are off board. It's not immediately clear why the machine's designers chose to put these functions on a peripheral card, unless it was that there simply wasn't any room left on the motherboard.

One of the things which drives people mad about AT compatibles is setting them up. The setup program usually asks you what type of hard drive you have. Good luck figuring it out. The AVX-386 has the hard drive type marked on a sticker slapped on the power supply. A low level innovation, this, but something of a frustration saver.

In practice, the speed of the AVX-386 seems rather more noticeable than it does on paper. There seems to be some sort of perception threshold for software, after which one's brain merely regards it as fast. All my favourite slow programs just jumped into warp nine when I trucked them over to the AVX-386. WordStar 3.3 became a real word processor. The occasionally cranky Personal Composer not only ran without a hitch but compiled its scores faster than even an optimistic engineer at Best would have suspected was possible. The Lattice C compiler, a bit of a slug most of the time, fairly tripped over its own boot laces in its haste. Turbo C compiled so quickly as to put all sorts of Einsteinian physics in jeopardy.

Perhaps more to the point, however, is that nothing misbehaved on the AVX-386. Even my really unkind benchmark programs, specifically designed to die colourfully in the event of an incompatible computer, survived to return to DOS unscathed. Public domain software that barely ran on other machines also barely ran on the AVX-386, although it barely ran in very much less time. The machine is very much a stock PC running at the sort of speeds computers should go at. The compatibility it exhibited was most admirable.

HARD MONKEYS

Unlike a stock PC, of course, the AVX-386 can deal with substantially more memory. The machine I got came with a full six hundred and forty kilobytes of main memory and something like seven megabytes left over, to be used as extended RAM. Because of the way the 80386 can manipulate its memory, this can be moved around and meddled with in a number of ways after the system boots.

All this extra memory can, of course, be used as the gods' own RAM disk. Perhaps more intelligently, you can run spreadsheets in there which can calculate a company's finances down to the cost of the last paper clip. Unlike as with lesser computers, the incredible speed of the AVX-386 makes huge spreadsheets reasonably practical. On an AT, which also has extended memory available, the ability to manage great amounts of spreadsheet data was somewhat offset by the long recalculation times that such machines got into.

The AVX-386 will support either an 80287 or an 80387 math coprocessor. This means, among other things, that if you're upgrading from an AT you can bring this rather expensive chip with you. The only negative aspect about this is that both coprocessor sockets live under the hard drive. You have to do a fair bit of dismantling to install something in them.

Another nice touch in the AVX-386 is a facility for slowing the speed of the system down. This is useful if you try to play games on it, as most of the games I tried on the machine were totally unplayable with the clock running normally. Hitting control alternate one drops the clock speed to eight megahertz. Control alternate two pops it back to sixteen.

CUT BY THE LEADING EDGE

The AVX-386 is a really impressive machine. Despite the lack of a 386 standard at the moment, it seems a fairly safe choice. Even if it were to find itself totally outside an accepted standard tomorrow, it has enough power to be up there with the state of the art for some time to come.

While hardly inexpensive, the AVX-386 seems to be fair value in comparison to other similarly equipped machines. It has a local company supporting it, rather than a far Eastern one, which is unquestionably worth considering.

Best AVX-386: Price not available at press time. Contact Best Systems Corp of Canada Inc, 401 The West Mall, Suite 1110, Etobicoke, Ont M9C 5J5, phone (416)620-7400.

TOSHIBA T5100

BY WILLIAM MARKWICK

The Toshiba line of laptop computers now includes an 80386 based model. The T5100 is housed in a 12" by 14" gunmetal gray case. In the lid is a 640 by 400 pixel plasma display, 7.5" by 6", that lights up in bright orange. The keyboard has a full-size, 82-key unit with the ten function keys across the top; all the functions of the 101-key AT style keyboard are available with a special shift key. To further reduce the width, the separate numeric pad isn't there; numeric functions take over a section of the regular alphabetic keys when the Num Lock key is pressed.

On the right side is a 3.5" microfloppy drive, on both sides minuscule, quiet fans; on the inside is a 40 megabyte hard drive with a 29ms access time.

The first impression of the T5100 is one of solidity and precise construction. The weight, at 15 pounds, is a tad hefty... not bad for short trips, but quite a pull on the arm if you have to lug it around an airport. The surprise is that there is no battery, only an AC line cord and power supply that automatically sets itself to the voltage of whatever country you happen to be in. Feeding a power consumption of about 70 watts, I suppose batteries wouldn't go very far, perhaps half an hour, and this may be the reason that Toshiba went with mains-only. Besides, airlines frown on the use of electronic equipment on aircraft in case it interferes with something and you end up in Hamilton instead of Paris.

The T5100 has an elegant fabric carrying case, with a pocket for the manuals and line cord. The computer itself has no carrying handle on the front where you'd expect it, though one does pull out from the rear and tilt down as a stand. This also uncovers the auxiliary connectors.

A Quick Tour

Switching on the power almost instantly brings up crisp orange lettering on a black background, informing you that the computer is under the control of MS-DOS version 3.2. The screen is driven by a video card that emulates the IBM Enhanced Graphics Adapter and provides four shades of gray; a utility called XCHAD is included to adapt various colors to this gray scale for best contrast, something you'll appreciate if you've ever tried to read white-on-light-blue on a monochrome monitor.

There are controls for brightness and contrast. They seem to work best at maximum when you're in a bright office, though you might want to turn the brightness down in a dimly lit room. Glare is not really a problem because you can tilt the display to suit lighting conditions. On the case beside the lid hinge are the power indicator and disk drive lights, which, oddly, are labelled L and R.

On the rear panel under the carrying handle lives a 9-pin D-connector serial port, a 25-pin parallel port which can be switched to accept a 5.25" external floppy drive, a 9-pin RGB monitor output connector and an expansion port which is designed for Toshiba products such as a modem, a memory card with another 2MB, or a 5-slot expansion unit which allows you to use IBM-compatible cards externally. A DIP switch allows you to configure parameters such as Extended Memory on/off, 512K/640K and so on.

On the left is the parallel port\disk port switch and a DIN connector in case you want to use an external keyboard.

TRYOUT

Toshiba didn't send us any software except for DOS and a demo program with remarkably good animation. We loaded WordStar version 3.3, WordStar version 4, and AutoCAD. Immediately we discovered that WordStar 3.3 doesn't like the EGA mode; although it runs properly, it won't exit without making a mess of the screen. This is not a fault of the Toshiba, but of WordStar.

WordStar version 4 was much more interesting in terms of the hi-res EGA. It's possible to use WSCHANGE to patch WS for 43 lines (of 80 columns) instead of 25. This lets you see almost all of a full page of text. The T5100 screen was more than up to the task of displaying the much smaller lettering.

AutoCAD loaded much faster than on my Best Mark IV. After I loaded in the ubiquitous Columbia shuttle, regeneration times were 10 seconds for the T5100 and 11 seconds for the Best. With a much more complex drawing with lots of text, the 8087 equipped Best edged out the T5100 58 seconds to 62. In other words, the T5100 without a math chip is as fast at AutoCAD on a Turbo 8086 with a math chip.

The plasma display was really impressive, despite the fact that it's smaller than my hi-res monitor's screen. In fact, the screen pixels are so precise, I soon came to prefer it. And, of course, who could argue with almost instant operation?

OTHER FEATURES

Should you discover some software which doesn't like the 16MHz clock speed, you can use a software switch to set the clock to 8MHz. This is done by pressing the special Fn key and the PgDn key. This Fn can also be used to switch output over to the external RGB socket, or to change the number of pixels in a row from 350 to 400. It can also simulate keys not present on the keyboard, such as right CTRL and right ALT.

For optional equipment, you have a choice of a 5.25" external floppy drive, an expansion interface, a modem, two more megs of RAM, a Floppy Link for connecting to the drive of an existing computer and more.

As to complaints, I can only nitpick. I'd really like a handle on the front, and the lid release is too easy to trip. My only *major* complaint with the T5100 is that I can't afford it.

Toshiba T5100: $11,499 with 40 Mb hard disk and one 720K microfloppy drive. Contact Toshiba Information Systems Division, 191 McNabb Street, Markham, Ont L3R 8H2, phone (416)470-3478.

ZENITH Z-386

BY BRIAN GREINER

The Zenith Z-386 is as well equipped as any of the 80386 systems we've been checking out. It starts off with a megabyte of RAM, a single 1.2 megabyte floppy drive, a 40 megabyte hard drive, serial and parallel ports and a display adaptor capable of handling CGA, EGA, and Hercules modes. The system that I received for review included an extra three megabytes of RAM, an 80287 math coprocessor, and the Zenith ZCM 1490 colour monitor. More about the monitor in a bit.

Inside the case lurks a 200 watt power supply and a well constructed motherboard. Unlike other systems, the Zenith motherboard has little more on it than slots for boards to plug into.

There are 10 slots, but once one finishes plugging in all the necessary cards, there are only five slots free for future expansion. These spare slots include three 32 bit proprietary Zenith types, one 16 bit PC/AT slot and one 8 bit PC slot. In the absence of 32 bit bus standards, Zenith wisely chose to just extend the original PC design. This means that the 32 bit slots will also accept any card that can be used in a standard PC... but *not* the extended AT cards.

SPEED DEMON

The Zenith CPU card holds the 80386 chip plus other assorted goodies. One very nice feature is that the card can handle both the 80287 and 80387 math coprocessors.

The CPU card can interface to an optional cache memory card. This is a small amount of zero wait state buffer memory that lives between the CPU and the main memory. Its purpose in life is to remember the last memory location accessed, and some of the bytes to either side of it. This can speed up the average memory access time, eliminate processor "wait states"... that is, idle time... and effectively increase the speed at which the computer can process a program.

The Zenith video card is quite an impressive piece of business, supporting multiple video modes as well as two monitor types. It appears to be built around the industry standard Chips and Technology display chips. Emulations include the four most popular video standards; CGA, EGA, MDA and Hercules. The different modes can be selected via a DIP switch or via the system's built in "monitor" program.

The keyboard that comes with the system is one if the better ones that I've used. It has the standard AT style layout, but with the function keys along the top of the keyboard.

The manual is a 110 page, spiral bound booklet. The style lives up to the clarity, precision, and quality of writing that one expects of Zenith. It clearly explains what the system has, how to access it and how to add extra boards and disk drives. It even includes basic troubleshooting information, down to the board level. The only real deficiency is that the text is a bit terse and has an "overview" feel to it... for example, when explaining the configuration jumpers on the various boards. The other omission is that it really doesn't try to explain anything about machine specific software.

The ZCM 1490 monitor deserves special mention. It is Zenith's 14 inch, 31.49 KHz analog colour monitor, and uses their flat CRT technology. That is, the screen of the CRT is perfectly flat, unlike standard CRT's, which are curved. This results in an image that is undistorted and free of glare from surrounding lights. The colours are rich, crisp, and bright. After working with it, no other colour monitor seems acceptable.

I ran some benchmarks on the system and came up with the following results. The Norton SI index was 17.5, that is, the Zenith runs at seventeen and a half times the speed of a stock PC. I also ran one of my own benchmarks, the Savage test, which repeats a series of intricate floating point calculations a number of times. This makes a good measure of how fast the computer can crunch numbers. On a normal PC the program takes 164 seconds. It ran in 18.0 seconds on the Zenith, and in 1.7 seconds on the Zenith with an 80287 math coprocessor installed.

Alas, even the best of things has flaws, and the Zenith 386 is no exception. My Turbo Pascal 4.0 programs had some problems running graphics in EGA mode, although they worked fine in both CGA and Hercules modes. The problem is undoubtedly due to some interaction between the EGA software driver and the video card's hardware. This sort of problem is not uncommon with other multimode video cards.

My biggest disappointments were its failure to run Windows/386 and 386^{Max}, two programs expressly designed for 386 based machines. I installed Windows/386 with no problems, but when I tried to run it the program claimed that I had an invalid version of DOS. The DOS installed on the Zenith was version 3.2, and Windows claims to work with versions 3.1, 3.2, and 3.3. I rather suspect that the problem was in the BIOS. The technical support person at Zenith said that I required MS-DOS 3.21 or better to run Windows This seems strange, since I've run Windows on a machine with MSDOS 3.1. The BIOS theory was further strengthened when 386^{Max} refused to work. In fact, the system hung when I tried to run it, forcing me to turn off the power to reboot the system. Qualitas, publishers of 386Max, have acknowledged the incompatibility, and promise that the next release of their software will remedy the situation.

POWER DOWN

In conclusion, this system is a very nice piece of work. The hardware shows quality of both design and construction. The ZCM 1490 monitor is a welcome advance in CRT technology. The system ran all the 8088 oriented software that I tried, but failed to run two of the three 80386 oriented packages. This is somewhat disturbing, and casts a shadow on an otherwise excellent machine.

Zenith Z-386: Price not available at press time. Contact Zenith Data Systems, 1020 Islington Ave, Toronto, Ont M8Z 5X5, phone (416)231-4171.

APRICOT XEN-i 386/100

BY BRIAN GREINER

Somehow, one has come to expect microcomputers to originate from California. Perhaps it's because of the impression that the microcomputer revolution originated in there, or perhaps its just a case of successful advertising. At any rate, it may come as a surprise that state of the art microcomputers are now being exported from Britain. A prime example of this new wave is the Apricot XEN-i 360/100, an 80386 based microcomputer.

The XEN-i is a good example of the newly emerging super AT's. It offers both hardware and software compatibility with the older PC and AT machines, but adds the performance of the fast 80386 processor. This makes the beast as big an improvement over the AT's as the AT's were over the original PC's.

PEACHES AND CREAM

Physically, the XEN-i is unlike the run of the mill microcomputer these days, being based on the "tower" configuration promoted by IBM on its high end PS/2s. The XEN-i is expressly designed to sit on its side, so as to not take up any desk space. This is a considerable step forward in human engineering, since most desks tend to have very little free space. What's more, the designers have even added wheels, to make trundling the XEN-i around from place to place a bit less of a strain.

In terms of actual inches, the XEN-i is 25 inches high (including wheels), 7 inches wide and 21 inches deep. The colour is the mandatory beige. Isn't there anyone besides myself who would like some real colour on their computer case? Still, the XEN-i is attractive enough, as these office boxes go.

The unit incorporates not one, but two fans... top and bottom... for truly arctic cooling. Although this arrangement may do great things for the longevity of the electronics, I wish the designers had paid slightly more attention to the sound produced by these fans. One expects computers to make some sort of gentle noise... but the dual fans on the XEN-i sound a bit like a jet engine reving up for take off. This could be a drawback in a quiet office.

The rear of the unit has a large sticker that shows exactly what the system contains. Included is such information as the type of disk drive, amount of memory and the other assorted data required when configuring applications software. Most manufacturers simply bury this information in manuals. Apricot makes it readily available.

Looking under the hood is simple and easy, and reveals just how well constructed the XEN-i is. There are two side panels that slip off after the removal of a few screws. On the inside of one of the panels is a crib sheet showing such things as how to hook up another disk drive, what the motherboard configuration switches mean, how to remove the backplane, and allocation of the power supply output connections. Just the sort of things one typically needs to know when forced to dig into the guts of a computer... but usually can't find out.

The XEN-i motherboard is actually a two tier arrangement. The larger, bottom layer holds all the electronics, including serial and parallel ports. The smaller second layer holds the expansion slots. There are no fewer than ten slots, and the only one used by default is for the video card! Of the ten slots, nine are AT style and one is PC style. This is surely the most free slots of any microcomputer I've seen, and more than enough for any foreseeable application.

The demo system that I received came with a 1.2 meg floppy disk drive, a 100 meg hard disk drive, 640K of system memory, 7 meg of expanded memory, and an 80287 math coprocessor chip. The BIOS is the 80386 system created by Phoenix, an therefore about as standard as you can get.

The keyboard included with the system is the obligatory AT style effort. It is as well crafted as the rest of the hardware, and offers excellent response with a very quiet action.

No documentation came with the demo system, but I had no problems setting up or running it.

A COUNTRY GARDEN OF BENCHMARKS

No review would be complete without tests. Actually, it'd be pretty hard to compare different systems without them. But please keep in mind that any benchmark is simply an indicator, not an absolute measurement. Your own best test is to run the applications you will actually be using. However, with that in mind, here are the results of our standard test suite.

The Norton SI index for the XEN-i was 17.6. The disk index was 2.7... a rather low rating that could probably be improved by fine tuning the disk format. The Computing Now sieve program returned a value of 90, as opposed to 1072 for a stock PC. My Savage floating point benchmark returned 19.3 without a floating point processor, which compares to 164 seconds on a stock PC.

As I mentioned before, the real test is how well a machine runs real software. With a machine like this, one particularly expects it to run software specifically designed to use the 80386. With typical British aplomb, the XEN-i ran practically every piece of software I threw at it. The 80386 specific software, 386^{Max} and Windows/386, ran without any problems at all. In fact the only program that refused to run was Jet, a flight simulation game for the PC.

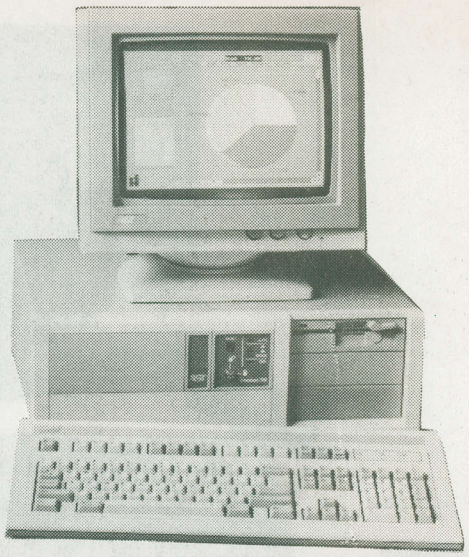
A FRUIT BASKET OF FUN

All in all, this machine is a delight to use. It is exceptionally well designed and constructed. The only nasty bit is that the fans are a bit on the loud side. Still, it ran virtually everything I tried on it. Even the price is surprisingly attractive.

This is one sweet machine.

Apricot XEN-i 360/100: $7995 with 30 Mb hard drive and one 1.2 Mb floppy drive. Contact AIC Computers Inc, 111 Granton Drive, Unit 401, Richmond Hill, Ont L4B 1L5.

AST PREMIUM 386



BY BRIAN GREINER

The AST Premium 386 is one of very few 80386 based systems that can be considered a "trend setter". It is frequently discussed in the same breath with such illustrious company as the IBM PS/2 Models 70 and 80, and the Compaq 386 systems.

Like Compaq, AST has taken the approach of extending traditional AT design. Just as Compaq has tweaked the old sixteen bit AT bus, so AST also has come up with its own sophisticated "SMARTSlot" bus. This is claimed to retain complete downward compatibility with earlier generations of hardware, yet provide many of the speed and configuration advantages touted by IBM for its own... incompatible... Micro Channel bus.

A PREMIERE SHOWING

Although the AST Premium 386 partakes of the standard beige colour scheme, the box has a very classy "designer" look to it... not to be mistaken for any bargain basement clone. The system unit measures 19 inches in width, 6 inches in height, and is 16 inches deep. This is not exactly a small footprint, but pretty much standard for the 386 machines I've seen. Space is provided for three disk drives, of which the standard system uses two.

Inside, there lurks a 220 Watt power supply, and the ever present motherboard. The motherboard has a total of six slots on it. Two of these are of the eight bit PC variety, one is of the sixteen bit AT type, and three are thirty-two bit "SMARTSlot" types. The SMARTSlot, AST's innovation, gives access to a sophisticated "arbitrated multimaster" bus structure that is also AT compatible. The SMARTSlots allow for a multiprocessor environment, provided that peripheral cards become available that are designed for such advanced things. Actually, the AST disk controller card that comes with the system is just such an intelligent beast. The enhanced bus structure allows the disk controller to do its job faster, resulting in peppier disk accesses.

The motherboard is also the home of the 20 Mhz 80386 chip. There is provision for both the 80287 and 80387 math coprocessor chips. This is a nice touch, since the 80387 chip is priced out of the reach of all but medium sized countries.

There is also the usual assortment of goodies, such as a 1.2 meg floppy drive, a 33 meg hard disk drive, 640K of system memory, and 1 meg of extended memory. There is also one parallel port and two serial ports. In a stroke of kindness and genius, the serial ports use the world standard 25 pin connectors. For some bizarre and sadistic reason, not too many 386 machines do this.

The system comes with the obligatory AT style keyboard. It's a pretty good one, as these things go, although I found it a bit mushy for my taste. Keep in mind, please, that keyboards are a very personal matter. I personally know people who would probably love this keyboard.

Video on my demo system came courtesy of AST's own EGA emulator card, the AST 3G Plus II. It seems like a pretty standard sort of offering as these things go. The little beast will emulate EGA, CGA, MDA, and Hercules. It can output to a variety of monitors including RGB colour, monochrome, and multisync. The card comes with a reasonably complete manual and a disk of testing software.

The documentation included with the system comes in two binders, each with its own slipcase. One binder is the user's reference guide, the other is the standard MS-DOS manual. The user's guide includes a pair of disks with special purpose utilities, and about an inch of documentation. The documentation clearly and comprehensively covers both the hardware and utility software.

THE SINGULARITY STRIKES BACK

It's worth reiterating our warning to take benchmark ratings with a grain of salt. Standardized benchmarks are notoriously unreliable at gauging actual system performance. However, they do provide some sort of a crude reference, so here are our own results.

The Norton SI value for the AST was 21.2, which is unusually fast. The disk index was 4.0, a highly respectable rating that deserves special note. A decent AT drive will usually rate about 3.5, so the AST's score can only prove that its SMARTSlot design has definite merit.

The Computing Now sieve program returned a time of 93, as opposed to 1074 for a stock PC. My Savage floating point benchmark returned 15.8 without a math coprocessor, which compares to a rating of 164 on a standard PC.

AST ran Windows/386 just fine. However, I had trouble installing 386^{Max}, a memory management program designed specifically for 80386 based machines. However, Qualias, publishers of 386^{Max}, have assured me that the program does indeed work perfectly on the AST. In fact, Qualitas was involved in creating some of the original software drivers for AST itself, so they know this particular system better than most. We'll have to have another shot at setting this test up, and find out where things got mixed up.

The AST also refused to run Jet, the popular flight simulator game for PC's. This is not much of a black mark against the system, not only because Jet is "just a game", but also because game software... and this game in particular... is notoriously finicky when it comes to fast hardware.

THE GREEN STAMPS HAVE LANDED

All in all I rather liked this machine. The hardware works well, and it executed the benchmark programs with good results. The documentation is both good and complete. AST has forged a very strong reputation for itself as a supplier of quality leading-edge systems, and you'd be unlikely to go wrong with the Premium 386.

AST Premium 386: $6995 with one 1.2 Mb floppy drive. Contact AST Canada, 6549A Mississauga Rd, Mississauga, Ont L5N 1A6, phone (416)826-7514.

COMPAQ PORTABLE 386/20

BY BRIAN GREINER

The microcomputer industry has a well defined pecking order. That is, there are some companies which are generally held to be more competent and brilliant than the rest. Companies of this nature have generally earned their reputation by simply being the very best in their field, not just by buying lots of advertisements. Compaq is one such company. Since their inception, they have consistently delivered quality and technical excellence. The Compaq Portable 386 is the latest... and greatest... in their line of portable microcomputers.

The Compaq Portable 386 compares to other 386 based microcomputers like a Ferrari compares to a Buick. Both do much the same thing, but the Compaq does it while packing more zip into a smaller package.

SMALL MIRACLES

The Compaq Portable 386 is certainly a feat of clever packaging. Somehow they have managed to cram a complete 386 based computer, including display, into a box only 10 inches by 8 inches by 16 inches! What's more, this little beauty only weighs 20 pounds. It's not a laptop, by any means, but it is easily portable.

What's more, the packaging design is exceptionally well done. This is the ultimate yuppie computer, equally at home on a boardroom table or in the back seat of a BMW.

The demonstration machine that I received included a 20 Mhz 80386, 1.2 meg floppy drive, a 40 meg hard disk, 640K of system memory, 1.7 meg of extended memory, and an 80287 math co-processor. The standard package also includes a serial and parallel interface.

Of course, Compaq offers a full line of optional add ons, including extra memory, internal modems, serial and parallel ports and an EGA card. As well, the system is offered with a 100 megabyte disk drive in place of the 40 megabyte one. There is also provision for installing an 80387 math coprocessor if the 80287 isn't fast enough.

The display is a 10 inch plasma screen. The colour is a rather pleasing orange, and the images are very crisp and sharp. When packed, the display sort of folds down vertically just like a side panel. It's unfolded by pulling it up and out. The hinge mechanism allows the user to adjust the viewing angle to a considerable degree. As far as software compatibility goes, it behaves like a CGA card.

The keyboard included with the system has the standard AT style layout. The feel is not bad, but perhaps a bit on the mushy side for my taste. The cord connecting the keyboard to the rest of the system is coiled much too stiffly, making it difficult to extend the keyboard very far away. However, this same stiffness makes for easy storing of the keyboard and cord.

The documentation that comes with the system is, as one would expect, well done. The only peculiarity is that the format is a non-standard 7 by 10 inches in size, oriented with the long dimension laid *sideways*. Included with the demo system was a spiral bound operations manual, two ring binders of technical reference manual and two binders of MS-DOS reference material. And all of it in the strange, non standard size. Perhaps it was done to make the manuals stand out in a bookshelf... some marketing hack's brilliant idea. Who knows.

Aside from its odd dimensions, the documentation is as well crafted as the computer itself. The technical reference manuals include system and BIOS information, aimed at those people producing hardware or software specifically for the Compaq.

A LITTLE BIT OF TESTING

The Compaq really leaves our little suite of benchmarks in the dust. Built on the same zero-wait-state cached memory design as the earlier 20 Mhz DeskPro model, the Portable 386/20 delivers phenomenal speed.

The Norton SI value for the Compaq was 22.0, which is the highest we've seen so far. The Computing Now! "sieve of Eratosthenes" test returned 82, as opposed to 1074 for a stock PC. My own Savage floating point benchmark returned 15.4 without a math coprocessor, which compares to 164 on a regular PC.

As far as compatibility, however, the Compaq makes reassuringly dull reading. It certainly ran every piece of 80386 software that I tried. Windows/386 installed and ran perfectly... no surprise, as Microsoft is rumored to have tailored the software to the Compaq in the first place. The memory management utility 386^{Max} functioned without any problems. The only program the Compaq didn't run was the Jet flight simulator game.

Strangely, I did find a couple of utility programs that refused to recognize the Compaq's hard disk. These programs were the standard SI benchmark program and a directory listing utility, SDL30. This is quite puzzling, as this is the first time these programs have ever had problems working on any computer system. Other programs that used the hard disk had no problems whatsoever. My only suggestion is that these two programs must directly access the hardware instead of going through the BIOS. When a program does that, all bets are off.

A LITTLE BIT OF MAGIC

It comes as no surprise that Compaq is currently "the one to beat" in 80386 equipment. Of course, you pay for the name... but in this case, the high price tag is probably justifiable.

It's difficult to remain objective about a machine like the Compaq Portable 386. It's about as state of the art as a consumer item can get. Everything about it smacks of professionalism and quality. It is, in a word, superb. My only problem with it right now is that my wife is captivated by it. Can one sue a computer for alienation of affection?

Compaq Portable 386/20: $12,399 with 40 Mb hard drive and 1.2 Mb floppy drive. Contact Compaq Canada Inc, 111 Granton Dr, Suite 101, Richmond Hill, Ont L4B 1L5, phone (416)733-7876.

PACKARD BELL PB386

BY BRIAN GREINER

Packard Bell is a company that has built up a reputation as a supplier of solid, plain-vanilla AT compatibles. Never the cheapest thing on the market, the Packard Bell's have appealed to buyers who are willing to spend just a moderate amount beyond the "rock bottom" clone price for a machine that's a lot better built and better supported than most clones.

The Packard Bell PB386 follows perfectly in this tradition. This is a simple, solid machine. It is as compatible as one could ask, and available at a price that won't totally devastate the accounting department.

RINGING THE CHIMES

Physically, the PB386 looks vaguely similar to all the zillions of other clones in existence. However, a closer look reveals that the case is not quite the standard design. Packard Bell machines are distinguished by a uncluttered, almost featureless facade, free of the usual assortment of non-functional "cooling slots" that adorn most Far Eastern imports.

There's a functional side to this. For instance, the front panel has a reset button handy for those times when the software goes berserk, but well recessed so that it would be difficult to hit accidentally. This is not exactly a lap top computer, but is pretty standard as AT compatibles go. It measures 21 inches in width, 6 inches in height, and 17 inches in depth. The usual double drive bay is visible, with a third bay hidden beneath.

Inside the box there's a 210 watt power supply, and... of course... the inevitable motherboard. The board has a total of eight slots, two are eight bit PC types and six are sixteen bit AT types. This is rather more AT style slots than most 386 machines seem to offer. A surprising omission is the lack of 32 bit slots. Virtually every other 386 machine I've seen offers some sort of proprietary 32 bit slot. These will generally work only with the manufacturer's own special expansion boards, but they do at least provide a route for high speed memory expansion.

The Packard Bell motherboard on our demo unit was equipped with a 16 Mhz 80386 chip. There is also provision for both the 80287 and 80387 math coprocessor chips. This is a nice touch, since the 80387 chip is priced out of the reach of all but medium sized corporations.

The demo system came with the also the usual assortment of goodies, such as a 1.2 meg floppy drive, a 33 meg hard disk drive, 640K of system memory, and 1 meg of expanded memory. The BIOS is from the Phoenix people, and as such is pretty much an industry standard. There were, however, no parallel or serial ports. Those could be easily added, however, with any one of the hundreds of boards sold for that purpose. Just figure in about an extra hundred bucks on the purchase price.

The keyboard included with the system is the usual AT style. It has much the same feel as the original IBM keyboards, which is to say, pretty decent.

An EGA emulation card came with the demo system, along with a multisync monitor. The EGA card worked just fine, which is about all one can say about such things. The monitor was a delight to use. The colours were sharp and bright.

The documentation included with the system comes in three binders, each with its own slipcase. One binder is the user's reference guide, another is the standard MS-DOS manual, and the third covers the inescapable GWBASIC. The user's manual comes with almost an inch of documentation. It is quite complete, and covers pretty much all aspects of the computer. The only serious omission is the lack of an index. This makes finding information a bit more time consuming and tedious than it should be.

FOR WHOM THE BELL TOLLS

Running at a mere 16 MHz, the Packard Bell demo system turned in benchmarks that are only moderate among the ranks of the 80386 machines. Still, performance is way ahead of all but the most exotic 80286 machines... and you get the benefit of running 80386 software.

Our Norton SI value for the Packard Bell was 17.6. The disk index was a somewhat lethargic 2.7, which could indicate either an inappropriate "interleave" format, or the need for a more expensive drive. The Computing Now! sieve program returned 104, as opposed to 1074 for a stock PC.

Compatibility tests with actual 80386 software gave a much more favorable perspective. Windows/386 installed and ran perfectly. The 386^{Max} memory management program functioned without any problems. The Packard Bell even ran the Jet flight simulator game without a hitch. The excellent display quality of the Packard Bell multisync monitor certainly enhanced the visual appearance of all these programs.

RINGING IN SHEAVES

It's difficult to properly rate this machine. On the one hand, it's 16 Mhz clock speed puts it on the low end of the 386 machine scale of things. The benchmarks reflect this, being about twenty percent slower than the 20 Mhz systems I tested. However, it's a well built, solid piece of work. And it did run everything I tried, unlike some of the other faster machines. When it comes right down to it, the ability to run software reliably counts for more than a small decrease in speed.

The list price for the 16 Mhz Packard Bell is reflective of both its moderate performance and bulletproof construction. Still, for a very slightly higher cost, Packard Bell also offers a full 20 Mhz system. Considering the price differential, the latter is probably the better buy. However, either machine should provide fast, worry-free service over the long haul.

Packard Bell PB386: 16 MHz version $6999, 20 MHz version $7499. Contact Packard Bell Canada, 7181 Woodbine Ave, Suite 230, Markham, Ont L3R 1A3, phone (416)47h9-5700.

HONEYWELL BULL SP

BY BRIAN GREINER

Up at the corporate end of the microcomputer spectrum, there's a demand for higher-priced but very well-built, very flexible systems. Honeywell Bull is a company well versed in the corporate appetites, and it's no surprise that the micros it builds are admirably suited to this market.

The Honeywell Bull 386 incorporates most of the same features common to the rest of the Honeywell Bull line. To begin with, it's based on a "backplane" design, in which the motherboard... such as it is... caries almost no circuitry. The computer as such is a peripheral card. This pleases many of the big users, in that it provides broad options in the disposition of the system. As it ages, the machine can be continually upgraded, or it can be drastically reconfigured for a new type of application.

Beyond this, he Honeywell Bull is simply a very robust, well designed office machine.

A TASTE OF HONEY

At first glance, the Honeywell Bull 386 looks much the same as all the other clones. There's perhaps a touch more grey in its colour scheme.

A closer look, however, shows that considerable thought has gone into the design of the case. For instance, there's a cunning little control panel, hidden under a door at the front, that conceals the inevitable key lock... and even a rarely seen *volume control* for the onboard speaker. A protective plastic rear panel, attached with velcro strips, helps maintain the visually pleasing look and feel.

The size of the box is not small, but is much the same as the majority of the 386 machines on the market. The width is 21 inches, the height is 7 inches, and the depth is 17 inches.

The motherboard is really no more than a convenient place to place the eight card slots. All the electronics are on the plug in cards. As mentioned above, this makes upgrading to a new processor fairly easy... and as it turns out, this unit is really just an upgrade of the Honeywell Bull AP/X AT-compatible microcomputer.

The actual computer electronics reside on a pair of cards, leaving six free slots. Two of the slots are 8 bit PC style slots, and four are 16 bit AT style slots. This allows plenty of room for adding extra goodies. The 220 watt power supply should be large enough for just about any application.

The demo system came with a 1.2 megabyte floppy drive, a 33 megabyte hard disk drive, 640K of system memory and a megabyte of extended memory.

The keyboard is sort of a cross between the older PC style and the newer AT style. The basic layout is PC style, with the function keys on the left side. However, there are twenty extra function keys along the top, corresponding to the shift and alt versions of the regular function keys. The keyboard has been made a little wider to accommodate special purpose cursor control keys, similar to those on IBM's new "enhanced" layout. The feel of the keyboard is rather nice, with nice tactile action to it. All in all, a very well done hybrid.

The documentation included with the system comes in three slipcased binders, covering user's reference, MS-DOS and GWBASIC.

The only problem that I had getting the system going was caused by a dead battery. As with most AT compatibles, the Honeywell's hardware configuration is stored in CMOS memory, and this must be continuously powered so that its contents aren't lost when the computer is shut down. With no spare battery on hand, I resorted to the painful expedient of reconfiguring every time I started up the system. There's a nice little program for this, but I'd have preferred to see less of it. It's been said before, but it's worth repeating: if you use an AT, keep a spare battery handy... especially over those long weekends.

SWEETNESS AND LIGHT

A 16 Mhz system, the Honeywell Bull turned in relatively modest benchmarks. Here's our sampling.

The Norton SI value for the Honeywell Bull 386 was 17.6, and the disk index was an unexciting 2.6. The Computing Now! "sieve" test returned 92, as opposed to 1074 for a stock PC. My own Savage floating point benchmark returned 18.0 without a math coprocessor, as compared to 164 on a stock PC.

The memory manager, 386^{Max} worked perfectly. However, Windows/386 refused to run, claiming that I had an unsupported DOS version. This was rather unfair of it, since I was running under MS-DOS version 3.2, and Windows/386 supports versions 3.1 through 3.3. Perhaps there is something not quite right with the BIOS of the machine.

I tried running programs for the PC on it, and almost all ran without any problems. However, the Jet flight simulation game wouldn't even boot.

THE COWS COME HOME TO ROOST

Physically, the Honeywell Bull is a very nice machine. It ran all sorts of programs written for the PC, but had problems with some 386 specific software. What this means, until 80386 standards evolve somewhat, is that anyone considering buying this machine for genuine 80386 applications had better test it out with their software first. Of course, this same warning applies to *any* 80386 system... precisely because the standards at present are still very loose.

What a buyer will get with the Honeywell Bull is a machine that will stand up to office abuse about like the average Sherman tank, and that will run PC or AT software perhaps not like an F-15 fighter, but at least like it had some form of jet propulsion going for it.

Honeywell Bull 386: Price not available at press time. Contact Honeywell Bull Ltd, 155 Gordon Baker Rd, North York, Ont M2H 3P9, phone (416)499-2855.

IBM PS/2 MODEL 70

BY MORRIS JAMES

The IBM PS/2 Model 70 is unique among the 80386 computers we've reviewed, in several ways. To begin with, it's the "genuine" IBM, the name brand. It's also the newest entry, having been introduced at the beginning of June. Finally, it's the only machine we looked at that isn't strictly AT compatible. This is a *PS/2*, through and through.

A PS OF CAKE

Being a PS/2 has its good points and its bad points.

Let's check the bad points first. Foremost is the execrable keyboard layout, with the control and caps lock keys relocated to almost useless positions. Next is the marginal compatibility... at least, on the gross physical level. We had trouble getting benchmarking software to run on the Model 70 for the simple reason that the Model 70 uses a three and a half inch microfloppy drive, unlike virtually all other computers in our office, and unlike any of the other 80386 machines we've been looking at in this supplement. Last, but not least, is the Micro Channel bus, which makes the PS/2 incompatible with all previous expansion cards, unlike all the other machines we've looked at, which generally provide both XT and AT slots.

So much for the negatives. If you can get by these, the rest is plain sailing, and the Model 70 turns out to be quite an attractive unit.

Being a PS/2, the Model 70 features lovely built-in VGA graphics. That means up to two hundred and fifty six colours on the screen, from a gorgeous palette of a thousand times as many. It also means you tend to end up with the default IBM monitor... admittedly not the very apex of display quality, but a fine piece of hardware nonetheless. If you haven't fooled with one yet, they have the power switch mounted at the top of their right side... that's *stage* right... and control and brightness in the same spot on the left. Unlike earlier IBM tubes, the PS/2 monitors have very effective antiglare frosting on the front.

Being both an IBM and a newfangled PS/2, the Model 70 has exceptionally fine construction and design. This appears chiefly in the details. For instance, the keyboard cord unplugs from both the computer box and the keyboard itself, making for easier storage and shipping. The system power cord has a daisy chain type plug at the mains end, allowing you to easily plug the monitor... or any other piece of equipment... into the same outlet. There's a built in mouse port next to the keyboard socket. The power switch is located on the front panel, well shielded against accidental operation.

And the footprint is absolutely *tiny*. The system box measures only 14 by 16 by 6 inches... almost as deep as your standard AT, but only half to two-thirds the width. The Model 70 will save almost as much desk space as those spacey looking "tower" units. The latter are getting much acclaim, but ignore the sad fact that you still have to put your monitor *somewhere*.

MODEL HOLMES

Our Model 70 demo unit was unique in yet another way, not mentioned so far. Unlike the other systems we checked out, the Model 70 came equipped not with MS-DOS, but with IBM's own brand new version 1.0 of the OS/2 multitasking system.

I put OS/2 through all sorts of odd paces... in the absence of actual OS/2 software, using the DOS "compatibility box". Despite fears that have been voiced about this environment, I found that it handled even bizarre combinations of public domain resident utilities without complaint. OS/2 itself looks lovely... enough like DOS to be comfortable, with enough new features to choke a hippopotamus. It does tend to clutter your root directory, and certainly accounts for a mega-chunk of storage space.

The Model 70 we got in was "only" the 20 Mhz version, not the faster 25 Mhz fireball. Nonetheless, the benchmarks were healthy... 20.9 on the Norton SI, 84 on the Computing Now! sieve. Oddly enough, when run in the compatibility box Norton reported that the machine was running DOS "version 10"! Presumably this is deliberate on IBM's part. Even more oddly, SI refused to do a hard disk test, redundantly claiming that "only hard disks can be tested".

The Model 70's onboard VGA display provides just about *the* fastest video available anywhere. On a crude benchmark, the screen writes about ten times faster than your average EGA card. BIOS text writes... normally a pokey procedure... are virtually instantaneous on pretty much any of the PS/2 series, and simply unbelievable on the Model 70. This greatly enhances the perceived speed of the system. WordStar 3.3 on the Model 70 pages up and down almost faster than you can see... if anybody still looking.

NOT MY TYPE

My greatest complaint with the Model 70 is the same one I've leveled at all of the PS/2 series. I will *never* get used to that diabolical keyboard layout. The control key belongs over by a typist's pinky. Nobody needs to toggle caps lock on and off that often... if they actually did, they'd be better off using the shift key anyway!

However, on the positive side, the keyboard has IBM's usual lovely tactile response. In fact, compared to most clones, this whole computer is built like it suddenly dropped in from some future century. IBM's on the right track with the engineering and human design. If you don't mind abandoning the old XT/AT bus... *and* all semblance of a rational keyboard layout... the PS/2 starts to look very attractive indeed.

IBM PS/2 Model 70: from $8,845 for 16 Mhz, 0-2 wait states, 1 Mb memory expandable to 6 Mb, 60 Mb hard disk, up to $16,645 for 25 Mhz, 0-2 wait states, 64K RAM cache, 2 Mb memory expandable to 8 Mb, 120 Mb hard disk. Contact your local IBM dealer.

TANDY 4000

BY AUGUST WEST

Like most of the current generation of 80386 based computers, the Tandy 4000 is essentially an AT compatible. This means, for example, that it lacks the hardware sophistication of the PS/2 systems, despite its 80386 processor. However, it also means that the Tandy is pretty much guaranteed to run most conventional PC style software, and to use all the readily available expansion hardware.

The Tandy 4000 is certainly a good machine to consider if you want to run PC compatible software at extremely high speeds. This is one of the most sophisticated, and fastest, AT compatible machines imaginable, and it's available at a rather decent price... especially comparted to some of the other systems we've been looking at.

BACK AT THE SHACK

The Tandy 4000 is a pretty conventional looking system. Like previous Tandy offerings, it is not exactly a thing of beauty, but what really matters is what's under the hood.

The machine I got for review had one quad density five and a quarter inch floppy drive, one meg and a half microfloppy drive and one forty megabyte hard drive. It also had two megabytes of SIM-mounted memory. The whole effort is run by a well implemented Phoenix BIOS. The CMOS setup utility seems to be integrated into the BIOS ROM, a nice touch.

The review system also included a first rate monitor and an EGA compatible display adapter, so it ran pretty well anything I could think of. Its Phoenix BIOS ensured that it was universally software compatible with a conventional PC, and about the only thing it had trouble with were a few public domain games, which ran too fast to be playable. One of the AT slow down programs, such as CPUSLOW, would have remedied this, of course.

Even the keyboard worked nicely, something which "appliance" computers aren't renowned for.

I tried a number of applications on the Tandy 4000. The review machine came with an 80287 math co-processor, making it a natural for use with CAD programs. The combination of the math chip and the 80386 running at sixteen megahertz made the usually lethargic AutoCAD into a blinding speed demon, redrawing complex screens in seconds instead of minutes. The effect of this has to be seen to be fully appreciated, and then only after you've used AutoCAD on lesser machines for long enough to get truly sick of it. If you do a lot of drawing this might well be enough to justify the cost of an 80386 system all by itself.

WordStar 3.3, ever faithful word processing slug that it is, takes on new life on the Tandy 4000, behaving almost as fast as something like PC-Write, which has a memory mapped screen, of course. WordStar is another of those programs which is uniquely unforgiving of hardware incompatibilities, especially when they occur in the video card it's given to run with. None of these hassles cropped up, and WordStar ran as I'd never seen it run before.

I tried some Turbo C programming on the Tandy 4000, which was quite a blast. Compiles were alacritous, even for Turbo, and the resultant code exhibited no peculiarities. This included some things that were really cruel to the machine, meddling with its vectors and writing directly, and rather crudely, to the screen. If there are any software incompatibilities in the Tandy 4000 they're unbelievably well hidden.

The extra memory in the system has a number of potential applications, and there being so much of it really does offer some interesting ideas for its use. The first thing I did with it was to create a gargantuan RAM disk with it, which did prove useful with some applications that wrote a lot of temporary files to the disk while they were working. WordStar running in this disk moves faster still.

There are, of course, applications which can make rather better use of this extra memory. Lotus will use it for truly massive spreadsheets, and if you expand this space out to four megabytes you can probably write a spreadsheet which will keep track of the location of every single molecule in the entire universe, including the ones comprising the computer. Of course, the recalculations for such an effort might get prohibitive.

Applications such as Publisher's Paintbrush can use this extra memory to hold extensive graphics images.

The Tandy 4000 uses traditional MS-DOS, of course, but it will run with OS/2. Some initial experiments with an early copy of OS/2 that we were sent indicated that the Tandy 4000 has no problem with the new generation of operating systems, although my time with it was a bit short. At the moment, I don't have enough OS/2 specific applications to really be able to judge the system's compatibility with OS/2, or its performance relative to other OS/2 compatible computers.

CHAIN LIGHTNING

There isn't as much to say about the Tandy 4000 as there is about other systems because it does work so well and so predictably. Its principal attractions are its speed and its price, and if these are prime considerations of the next computer you buy then the 4000 is an excellent prospect.

One of the best reasons for buying one of these systems is not even inside the case. The Tandy 4000 is readily available from any Radio Shack, and can be brought back to one for service if it decides to check out. This is as opposed to some of the imported machines, which come with pretty dreadful service facilities. In addition, of course, there will most likely be Radio Shack stores in a year or two, which is not so easily said about some of the smaller computer companies. Some of them seem to have the operational life of a mature fruit fly.

Tandy 4000: $4595 with one high-density floppy drive. Contact Radio Shack division, Intertan Corp, 279 Bayview Drive, Barrie, Ont L4M 4W5, phone (705)728-6242.

FUTURETRON SYSTEM MICRO 386

BY BRIAN GREINER

The Futuretron System Micro 386 is, in effect, a souped up AT machine. That is, it's got the chassis of an AT but has a 386 for an engine. Thus, it can run all the standard PC and AT style software and hardware. However, it will run the old stuff at previously unattainable velocities. Although it's a locally built machine from a smaller company, the Futuretron 386 racked up performance scores rivalling those of the most expensive machines in the market.

A LOOK INTO THE FUTURE

The box that contains all the magic comes in the mandatory beige colours, and measures 21 inches wide by 6 inches high by 15 inches deep. The front panel holds a reset button (a useful alternative to the power switch when the system hangs), and a switch marked "turbo" which has absolutely no functional use, as far as I could tell.

Inside, one finds a 1.2 meg floppy drive, a 32 meg hard disk, 640K of system RAM, and one meg of extended memory. Unfortunately, there is no room for additional disk drives. Memory is of the zero wait state variety, which allows the 30386 CPU chip to perform to its maximum speed. The BIOS is by a company named Quadtel... of whom I've never heard tell... and offers EGA support modes for multisync type monitors. A nice touch is that the system allows either the 80287 or 80387 math coprocessor chips to be used. There are seven AT style slots, allowing the use of any standard PC or AT boards, but no 32 bit slots.

The standard system comes with two each of parallel ports and serial ports. An unusually wide-awake designer made one of the serial ports the AT standard 9 pin variety, and the other the real world standard 25 pin type.

The keyboard that came with the system was a bit different from any other that I've tried. The layout was the standard AT style, but the feel was strange. When pressed, a key would not move at all until a certain threshold pressure was reached, and then it would offer no resistance to movement whatsoever. This was sort of like a click feel, but without any sound. In fact, it was one of the quietest keyboards I've ever used. However, after typing at it for a while, I found that my hands were getting tired from having to exert so much pressure on the keys. Still, keyboards are very much a matter of personal taste.

The standard video card is capable of emulating EGA, CGA, MDA, Hercules, and even VGA modes. It can make use of standard TTL monitors as well as the newer multisync tubes. I tried it out with both, with good results. The various modes are toggled by means of switches on the motherboard. Unfortunately, reaching these switches involves five screws and a solid pull to get the chassis out of the frame. Most of the newer video cards have these switches easily accessible from the back.

The Futuretron documentation consisted of twenty-two xeroxed pages held together with a single staple. This was mostly pretty technical stuff concerning configuration switch settings, connector pin outs, and the like. It seems more like a technical appendix of a manual, as opposed to a manual *per se*. This is definitely not for beginners or technophobes.

REACH INTO THE FUTURE

Despite some of its outward funkiness, the Futuretron 386 really broke away from the pack when it came down to pure *performance*. The Norton index, for instance, came in at a whopping 22.0, tying the Futuretron with the awesome Compaq Portable 386/20. The disk index, on the other hand, was was a rather disappointing 2.4, which would definitely indicate a need for a change in the mass-storage department... possibly something as simple as a change in interleave.

The Computing Now! "sieve" test gave a result of 82, as opposed to 1074 on a stock PC. My Savage floating point benchmark was 14.9 without a math coprocessor, which compares to 164 on a PC.

I ran a variety of different pieces of software on the Futuretron 386, including 386^{Max}, Windows/386 and the aviation game Jet. Surprisingly, the only program that wouldn't run was Jet, which simply wouldn't boot. This may be a real blessing for corporate suits, though, since it will prevent employees from wasting company time on a frivolous game.

One thing that I noticed while using the machine was that the display had the crispest response of any that I've used... fast even for a 386 based machine. Perhaps this is due to the zero wait state RAM used.

A BRIGHT FUTURE

All in all, this is a solid piece of work. It has excellent performance, and ran all the software I tried, with the unremarkable exception of the game Jet. Other graphics oriented software that I ran worked just fine. The keyboard seems a bit stiff, but such things are very much a matter of personal preference... and personal haggling at purchase time. The documentation is very brief, and might tend to discourage the novice. Nevertheless, this machine is definitely worth a long, carfeul look.

Futuretron System Micro 386: Price unavailable at press time. Contact Futuretron, 7500 Woodbine Avenue, Unit 108, Markham, Ont L3R 1A8, phone (416)477-8901.

Many of the machines in this supplement have been reviewed in greater depth than the limited space available here has allowed. If you are considering buying one of them, you might wish to consult the complete reviews, available in our back issues. Please contact our circulation department for more information about the availability of back issues.

JABA JB-386

BY MORRIS JAMES

It's no longer really necessary to seek out the big brand names just to get real big computing horsepower. Jaba System, for instance, is a local... Markham, Ontario... company, with some very big ideas. Its JB-386 is a largely homegrown design... based on the redoubtable Chips and Technologies chipset and the equally doughty Phoenix BIOS.

The JB-386 is very typical of what can be wrought by simple good sense and... relatively... stock components. The machine is solidly constructed, very standardized, and runs like a rabbit with its tail on fire.

The design of the Jaba is comfortingly conventional... for a 20 Mhz 80386, that is. The motherboard is based on the Chips and Technologies 80386 chipset, which makes the machine about as compatible as a 386 system can get. Further enhancing compatibility is the well established Phoenix BIOS, in its first 80386 incarnation.

The Jaba motherboard comes standard with 2 megabytes of memory, "interleaved" to reduce processor wait states to near zero. Memory interleaving places alternating memory addresses in separate physical banks. The theory is that when addresses are accessed in series the two banks area actually accessed in alternation, giving each one a bit more of a chance to respond. Numerous other 80386 systems use this approach, including the original Compaq DeskPro 386. It is said to be slightly less effective than memory caching... as used on the newest Compaq Portable we've been looking at. However, the Jaba seems to defy the theory, as we'll see when we get to the benchmark results.

The JB-386board is equipped with a single 32 bit slot, to allow memory expansion up to the eight megabyte level. In addition, there are 6 sixteen bit AT slots and a single eight bit XT type slot... located over at the end, where it can best be used to hold a video card, sixteen bit varieties of which are still a bit scarce. A unique touch with the Jaba design is that the entire top surface of the motherboard has been given a solid layer of plating, which should provide excellent electrical "noise" isolation. This could be a significant factor, by the time you get into twenty megahertz operation.

Our test unit came with some generic variety of Hercules compatible monochrome video. According to its brochures, Jaba will also be happy to sell you EGA colour, if you want it.

The Jaba box is a good quality AT affair, with the added attraction of three accessible drive bays. This could be a valuable feature if you want to stash a tape backup drive.

The default keyboard on the JB-386 is one of those "clicky" feeling deals, that emulates the mechanical feel of IBM's own product. In fact, the touch of the Jaba keyboard really is excellent. Unfortunately, this particular keyboard also incorporates the vicious new PS/2 standard key layout, with the control, caps lock and cursor keys scattered all over the place. Most keyboard manufacturers now offer a choice of layouts, and the JB-386 could probably be had with something a bit more traditional, if you asked nicely. Of course, some folks may actually prefer the new layout... there's no accounting for tastes, as they say.

BLAZING BITS

The usual caveates about taking all benchmarks with a grain of salt may apply more strongly than usual in the case of our Jaba results. The JB-386 produced an all but unbelievable Norton rating... 24.2, to be exact. This beats out all the other 386es we've seen. Truthfully, I can see no reason why the machine would perform this much faster in real world applications. However, we can safely assume that the beast is *fast*!

On the other hand, the hard drive in our test unit gave a rather mediocre Norton rating... and almost certainly would have benefited from a change in interleave factor. The lesson here is that if you're getting into high performance hardware, it's worth exercising a bit of care to avoid creating bottlenecks. Still, the Jaba test machine had gobs of spare memory, so I installed Microsoft's SMARTDRV memory cache, and disk speed became much less of a consideration.

Next, I tried using the 386Max memory manager, from Qualitas... first of all to check compatibility, secondly to check the effect on video speed. The program ran perfectly, although its ROM mapping option needed to be disabled. Normally, the program copies your computer's slow ROMs... including the video BIOS... into fast RAM, resulting in a dramatic increase in performance, and particularly in screen speed. However, the Jaba has built in "shadow memory" of its own for caching the video BIOS. In fact, the Jaba has one of the fastest screens I've seen so far... easily rivaling the PS/2 Model 70's built in VGA display.

Our test machine was equipped with a math chip, so it seemed logical to try the system out on some CAD applications. With AutoCAD's brand new Version 9, the inevitable "St Paul's" cathedral drawing took about five seconds to regenerate. On an old eight megahertz AT sans coprocessor, the same operation takes close to two *minutes*.

PROSPECTIVE PURCHASE

Considering its fearsome power, the JB-386 sells for an amazingly attractive price. True "power users" should have very little trouble justifying this purchase! Also, although Jaba System is a relatively small company, it deals mostly with large contract sales. Therefore corporate, government or other volume buyers should find that they can get an even more attractive price.

All in all, the Jaba is probably one of the most attractive systems we've seen, in the high performance bracket.

Jaba JB-386: about $3000 basic, $6000 fully loaded. Contact Jaba System Inc, 170 Esna Park Drive, Unit 9, Markham, Ontario L3R 1E3, phone (416)477-6363.

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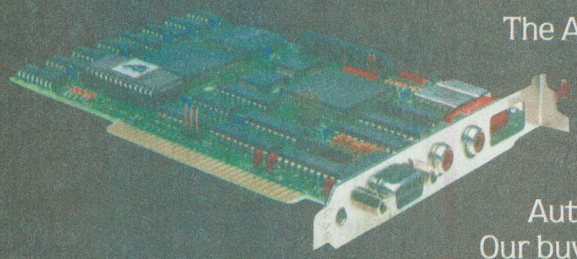

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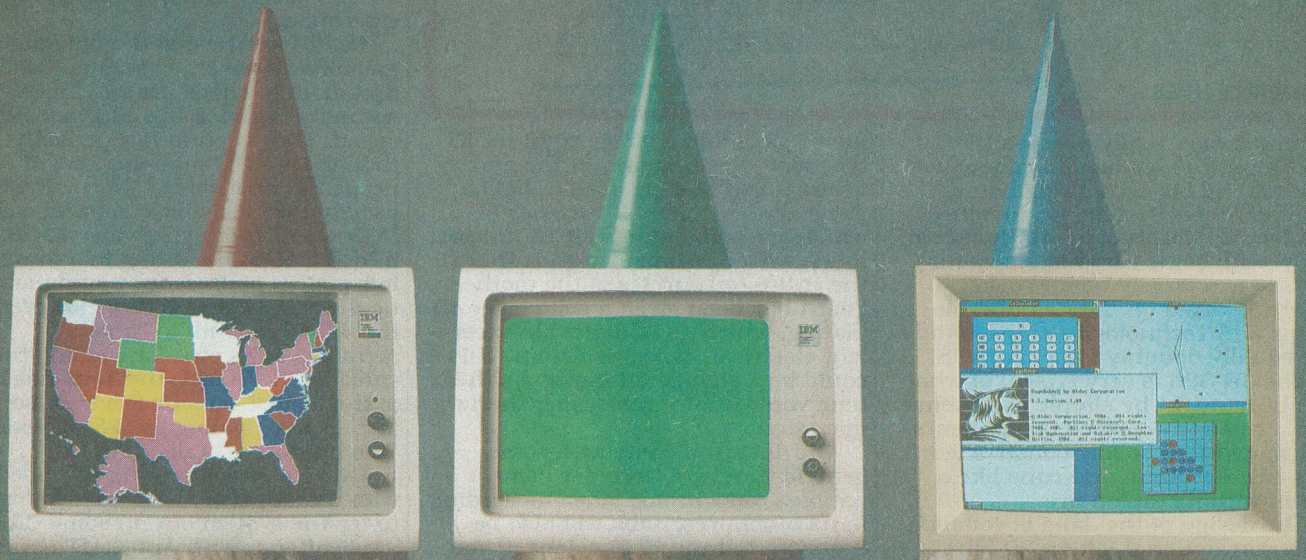

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Introducing Microprocessors, Part 5

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high-level language interpreters. Since its contents will not be lost when the power is disconnected, this is an ideal application for a semiconductor ROM. Furthermore, if it becomes necessary to update the control program, operating system or high-level language interpreter, it is possible to remove the ROM and replace it with a later version.

We shall now briefly consider the characteristics of each of the most popular types of semiconductor ROM device:

Mask programmed read-only memories

When large-scale production of a microprocessor based system is envisaged (as is the case with a home computer, for example), the most cost-effective method of implementing read-only memory is with the aid of a mask programmed device. Such devices are programmed by the semiconductor manufacturer who uses a mask to determine the data that will be permanently stored within the chip. The programming information (used to generate the mask) is supplied to the semiconductor manufacturer by the manufacturer of the microprocessor-based system.

Since the process is only cost-effective for quantities in the tens of thousands, it should be obvious that the manufacturer of the microprocessor system needs to be very confident that the stored data and program is free from errors and will require no further modification (which never happens).

Fusible-link programmable read-only memories

Fusible-link programmable read-only memories (PROM) are cost-effective for medium scale production and are programmed by the equipment manufacturer rather than the semiconductor manufacturer. The PROM consists of an array of nichrome or polysilicon fuses (see Fig. 5.1(a)). These fuse links may be "blown" by applying a current pulse of sufficient magnitude to rupture the link. Programming takes a considerable time but the equipment required is simple and relatively inexpensive equipment.

Often, early variants of microprocessor-based systems are supplied with PROM devices which are later replaced with mask ROM devices as soon as teething troubles and bugs have been eliminated and large scale production commences.

An alternative to the fusible-link ROM is the "blown junction" ROM shown in Fig 5.1(b). The operation of this type of ROM is similar to that of the fusible-link type but with the important difference that the diode junction is short-circuited rather than open-circuited during programming.

Erasable-programmable read-only memories

The programming of mask-programmed and fusible-link memories is irreversible. Once programmed, devices cannot be erased in preparation for fresh programming. The erasable-programmable read-only memory (EPROM) can, however, be "wiped clean" allowing the device to be programmed and re-programmed many times over.

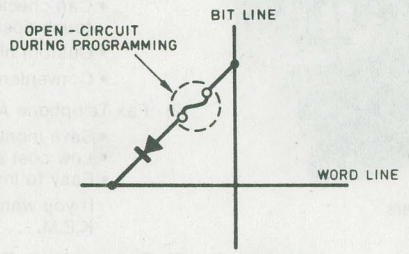

Fig. 5.1(a). Principle of the fusible link PROM.

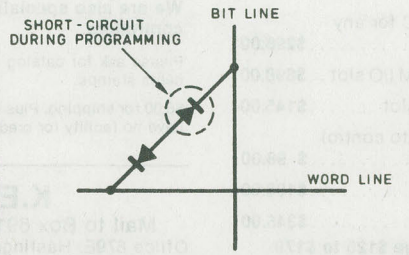

Fig. 5.1(b). Principle of the blown-diode PROM.

EPROM devices are fitted with a window which allows light to fall upon the memory cell matrix. When this area is exposed to strong ultra-violet (UV) light over a period of several minutes, the stored data is erased. The EPROM may then be reprogrammed using a low-cost device which supplies pulses of current to establish the state of individual memory cells. This process takes several minutes though some EPROM programmers can program several devices at once.

EPROMS are ideal for small-scale production and software development. They are, however, relatively expensive and thus are inappropriate for large-scale production. Typical capacities for EPROMs are within the range 2K to 32K bytes.

Readers may be forgiven for thinking that EPROM devices are really forms of read/write memory. In a sense they are: but it is rather more important to make a distinction between these memories and "true" read/write memories (e.g. semiconductor RAM) in which individual bytes can be changed at will.

Another important point is the time and ease with which a device may be reprogrammed with data. A single byte of data can be accessed from a semiconductor RAM in a typical time interval of 150ns. An entire 8K byte RAM can have its data changed in a time interval of 8192 x 150ns (plus an additional overhead for the processor). This results in a total programming time which can be measured in milliseconds. An 8K byte EPROM, on the other hand, may require several minutes of programming, not to mention the time taken for removal and erasure under UV-light.

Semiconductor Random Access Memory (RAM)

Microprocessors require access to read/write memory to implement stacks on which register contents can be stored during processing. Control programs and operating systems also require access to RAM for temporary storage of data and system variables. A further area must be made available for the user to store his or her own programs and data. In addition, where a faster scanned display is used, an area of RAM is usually devoted to a "screen memory". With modern systems, this reserved area of memory is invariably "bit mapped" (i.e. each bit of "screen RAM" corresponds to a particular pixel). The typical allocation of RAM on an 8-bit microcomputer might be as follows:

Function	Storage capacity	Notes
System variables	512 bytes	A fixed address is used for each system variable
Stacks	0–256 bytes	Changes in size during program execution
Screen memory	16K	Bit-mapped screen
User's program and data	Up to 31.5K	Amount used depends upon individual program

Static RAM

Static memories are based upon bistable cell configuration as shown in Fig. 5.2(a). This configuration will remain in a "set" or "reset" state (storing a 1 or 0) until changed or until the power supply is

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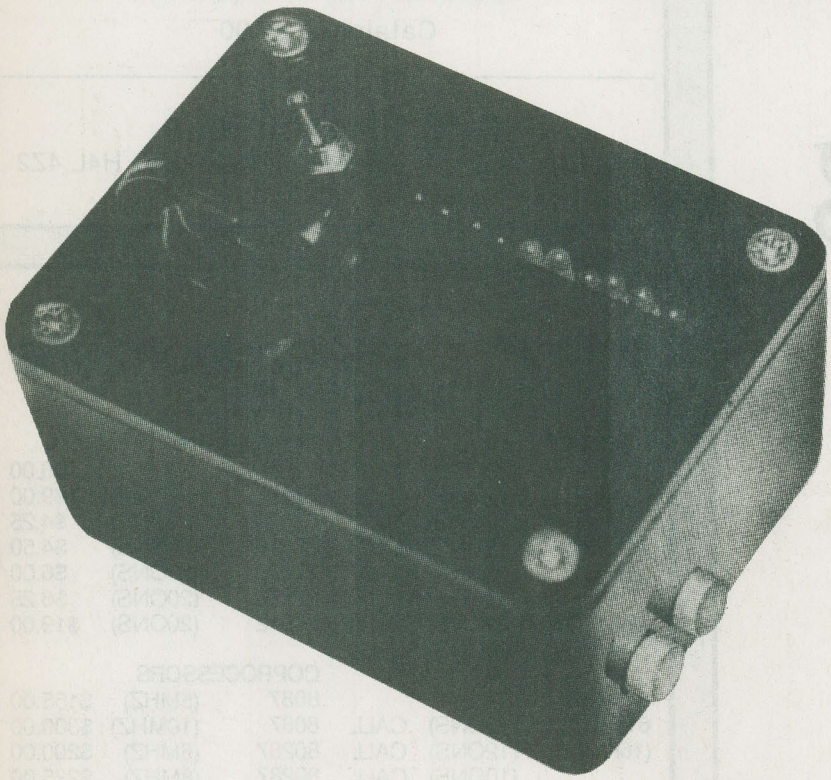
MARKET PLACE

MARKET PLACE

Lie Detector

We make no pretence to accuracy, but this simple skin resistance detector is instructive to build.

T.R. de VAUX-BALBIRNIE



It is well known that a person's skin resistance varies with the emotional state. For example, many readers will have experienced wet hands while waiting to see the dentist.It is this moisture, together with the presence of salt, which reduces the skin resistance. It may be easily measured using an ohmmeter with one probe held in each hand. A typical "dry" resistance is 200k ohms, but with wet hands it may fall to 10k ohm or less. This effect is used in the "polygraph" or lie-detector. Here, changes in skin resistance cause pens to trace graphs on a moving paper roll. From the appearance of these traces, an expert operator can judge, with debatable accuracy, whether or not the subject is lying.

This battery-operated device is much simpler than a professional polygraph, and then some. The subject holds a pair of electrodes and a row of ten LEDs glow, thermometer fashion, according to the skin resistance. It makes no pretence to accuracy — indeed, considerable training is needed to obtain reliable results from any type of lie detector. However, it is good enough for entertainment and may be used either in its own right or in games where the detection of a lie might prove helpful to an opponent, but don't bet the rent on this one.

Circuit Description

The circuit for the Lie Detector is shown in Fig. 1. The principle component is the bar driver IC1. This accepts an analogue voltage at the input, pin 5, and lights one of a row of ten LEDs connected to the outputs (pins 1 and 10 to 18) according to the voltage level.

The skin resistance, together with resistor R2 and potentiometer VR1, form a potential divider across the supply so a voltage appears at pin 5 whose value increases as skin resistance falls. This operates the IC in the manner described. VR1 sets the operating range and resistor R1 determines the LED operating current and hence their brightness.

Capacitor C1 prevents possible erratic behaviour caused by AC hum pick-up and also serves to slow down the response time. Resistor R2 prevents a short-circuit to the supply if the electrodes are allowed to touch while VR1 is set to minimum. The circuit is battery operated and so safe in use. On no account should it be converted to AC operation or an AC power supply used, or your first lie will be your last. The current requirement is about 20mA so the internal battery will give excellent service.

Construction

Most of the components are mounted on a circuit panel consisting of a piece of 0.1in. perfboard or Veroboard. Make all breaks in the copper strips as shown and insert the inter-strip links.

Mount the soldered components as indicated

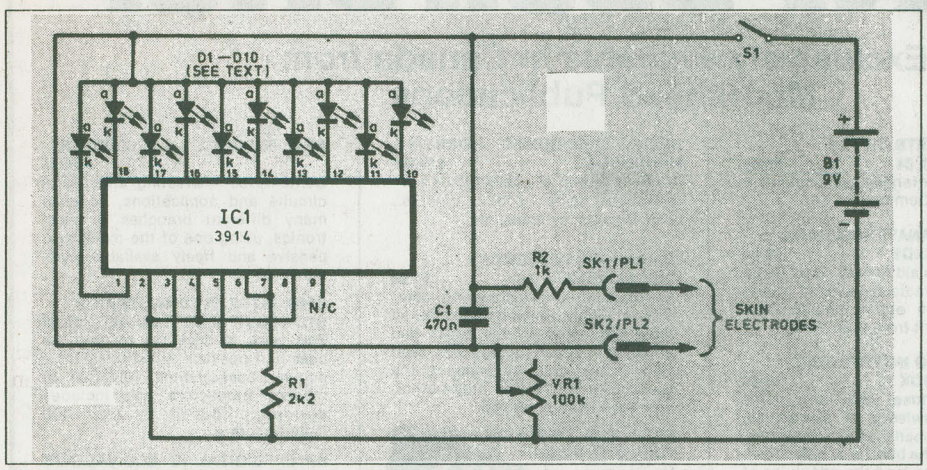


Fig. 1. Complete circuit diagram for the Lie Detector.

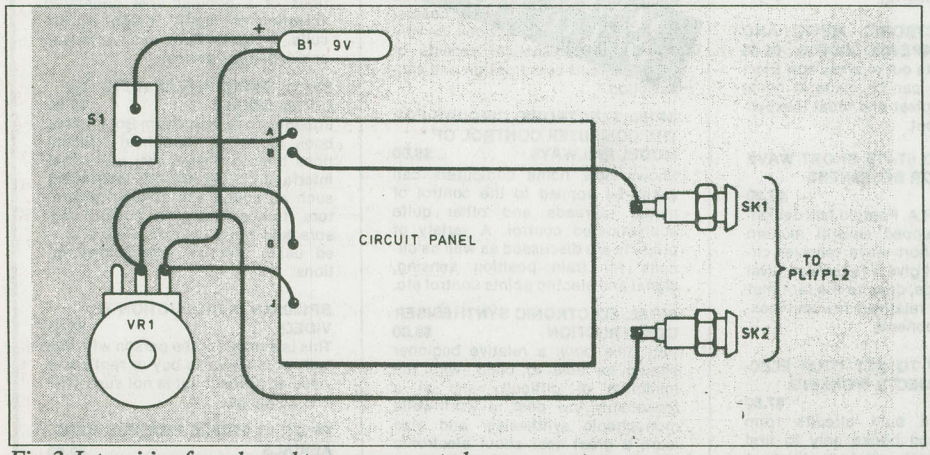


Fig. 3. Interwiring from board to case-mounted components.

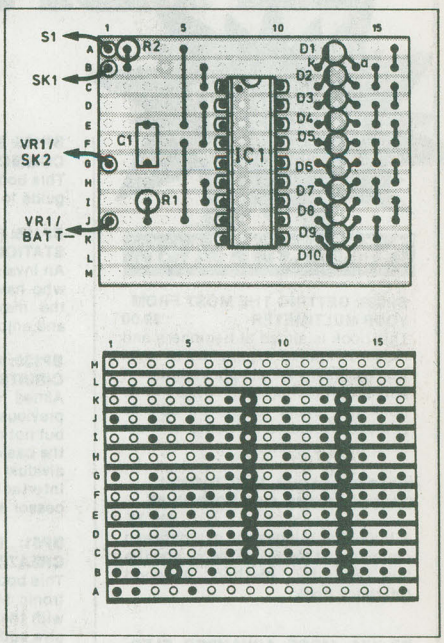


Fig. 2. Component layout.

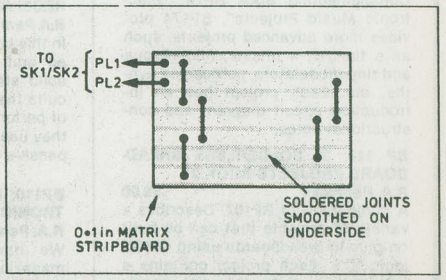


Fig. 4. Combination skin sensor electrode.

but do not insert the IC into its holder until the end of construction. Pay particular attention to the polarity of the LEDs and when soldering them in position, note that the wire ends must be bent gently so that the array occupies the whole width of the circuit panel.

Also, take care to ensure that all LEDs reach the same height. In the prototype unit, D1 to D4 were red, D5 and D6 yellow and D7 to D10 green. This adds to the fun but they could all be the same colour if desired. Solder 10 cm. pieces of light-duty stranded connecting wire to each of strips A, B, G and J as indicated.

Drill holes in the case of S1, VR1 and for the sockets. Cut a slot in the lid size 3mm x 40mm for the LED display. Mount the remaining components and complete all wiring as shown in Fig. 3. Without touching the pins, remove the IC from its special packing and insert it into its socket. This precaution is necessary since IC1 is a CMOS device and therefore liable to be damaged by static charge.

Fit the battery and secure the circuit panel with the LEDs occupying the slot in the lid. An adhesive fixing pad applied to the top of IC1 will serve this purpose. Attach the battery to the base of the box with a similar pad.

Electrodes

The choice of electrodes is left to the constructor and may be the subject of experiment. One may be held in each hand or they may be combined for single-handed operation. In two-handed use, response depends largely on the pressure which the subject exerts on the electrodes. This may be seen as an advantage since a nervous person will tend to grip them more tightly.

On the other hand, a combination electrode responds mainly to the presence of moisture. Such a device may be made from a piece of stripboard with adjacent copper tracks jointed together (see Fig. 4). It may be taped to the subject's palm with the copper strips touching the skin. Light-duty twin wire connects the electrodes to SK1 and SK2 on the unit.

Operation

Arrange the electrodes and switch on. Adjust VR1 for the required range of operation. Decreases in skin resistance will now cause the LEDs to glow in turn. Although the Lie Detector is great fun to use, the results should not be taken too seriously. ■

PARTS LIST

Resistors

R1 ..... 2k2
R2 ..... 1k
Both 0.25W 5% carbon

Potentiometer

VR1 ..... 100k min.

Capacitor

C1 ..... 470n

Semiconductors

IC1 LM3914N linear bar driver
D1-D10 3mm LEDs: red (4), yellow (2), green (4), (or 10 red)

Miscellaneous

Plastic case, 0.1in. Veroboard, 13 strips by 16 holes; S1 sub-miniature SPST toggle switch; pointer knob, plugs and sockets; 9V battery and connector; electrode materials (see text).

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Some of the most useful and popular electronic construction projects are those that can be used in or around the home. The circuits range from such things as '2 Tone Door Buzzer' intercom, through Smoke or Gas Detectors to Baby and Freezer Alarms.

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Electronic projects for model railways are failry recent and have made possible an amazing degree of realism. The projects covered include controllers, signals and sound effects: striboard layouts are provided for each project.

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Windscreen wiper delay, darkroom timer and metronome projects are included. Some of the more complex circuits are made up from simpler sub-circuits which are dealt with individually.

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS $7.80
R.A. PENFOLD

Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, Depth Warning and Shaver Inverter.

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Includes a collection of the most popular types of circuits and projects which, we feel sure, will provide a number of designs to interest most electronics constructors. The projects selected cover a very wide range and are divided into four basic types. Radio Projects, Audio Projects, Household Projects and Test Equipment.

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This book contains both simple and more adanced projects and it is hoped that these will be found of help to the reader developing a knowledge of the workings of digital circuits. to help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams. Also the more ambitious projects can be build and tested section by section and this should help avoid or correct faults that could otherwise be troublesome. An ideal book for both beginner and more advanced enthusiast alike.

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Twenty useful projects which can all be built on a 24 x 10 hole matrix board with copper strips. Includes Doorbuzzer, Low-voltage Alarm, AM Radio, Signal Generator, projector Timer, Guitar Headphone Amp. Transistor Checker and more.

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This book allows, the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

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BP195: AN INTRODUCTION TO SATELLITE TELEVISION $15.00

For the absolute beginner or anyone thinking about purchasing a satellite TV system, the story is told as simply as such a complex one can be in the main text.

BP108: $7.00

Cross-references European American and Japanese diode part numbers. Besides rectifier diodes, it includes Zeners, LEDS, Diacs, Triacs, SCRs, OCIs, photodiodes and display diodes.

BP88: HOW TO USE OP AMPS
E.A.PARR $11.80

A designer's guide covering several op amps, serving as a source book of circuits and a reference book for design calculations. The approach has been made as nonmathematical as possible.

BP65: SINGLE IC PROJECTS $6.00
R.A. PENFOLD

There is now a vast range of ICs available to the amateur market, the majority of which are not necessarily designed for use in a single application and can offer unlimited possibilities. All the projects contained in this book are simple to construct and are based on a single IC. A few projects employ one or two transistors in addition to an IC but in most cases the IC is the only active device used.

BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS - BOOK 2 $7.80
R.A. PENFOLD

This sequel to BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals. Amplifiers and filters account for most of the book but comparators, Schmitt triggers and other circuits are covered.

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Introducing Microprocessors, Part 5

Continued from page 29

removed. The use of NMOS or CMOS (rather than conventional bipolar) technology ensures that each cell consumes very little current and thus a very large number of cells can be present within a small area of integrated circuit.

Dynamic RAM

Dynamic RAM utilises the principle of charge storage within a capacitor. The simplified circuit of an NMOS dynamic memory cell is shown in Fig. 5.2(b). The charge stored in the capacitor, C, inevitably leaks away and thus dynamic memories require periodic "refreshing". The process of refreshing a dynamic memory involves periodically reading the data stored and then writing it back to the memory. Some microprocessors (such as the Z80) incorporate a means of refreshing dynamic memories, alternatively the task can be consigned to a dedicated dynamic memory controller chip.

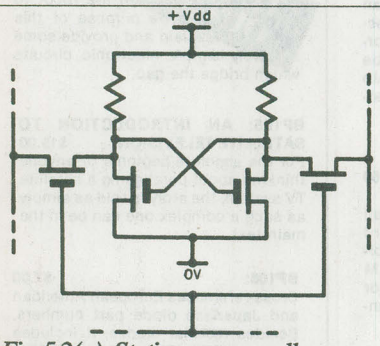


Fig. 5.2(a). Static memory cell configuration.

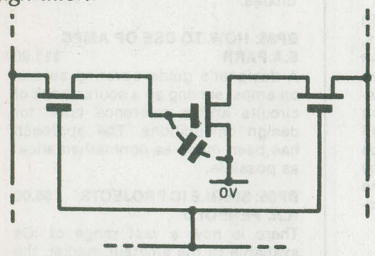


Fig. 5.2(b). Dynamic memory cell configuration.

Memory organization and storage capacity

Read-only memories are, for obvious reasons, "byte wide" (i.e. all eight bits stored at each location are contained within the same semiconductor device). Thus, a 4K byte EPROM would be organized as 4096 words each of 8 bits and its total storage capacity would be 32768 bits.

A wide variety of semiconductor RAM devices is currently available with storage capacities ranging from as little as 4096 bits (1K words x 4 bits) to as much as 262144 bits (256K words x 1 bit.

Each location within a semiconductor memory, whether it be ROM or RAM, comprises a "cell" at which a single bit of data (either a 1 or a 0) is stored. The memory cell matrix for a semiconductor RAM is shown in Fig. 5.3. The matrix comprises 64 rows and 64 columns and thus has a total of (64 x 64) = 4096 individual cells.

The six least-significant address lines (A0 to A5) are used to form the column address whilst the six most significant address lines (A6 to A11) are used to from the row address. Note that the action of the column and row decoders is that of selecting only ONE of the column and row lines at a time hence a unique cell is addressed which corresponds to the binary pattern placed on the address lines.

Fig. 5.3 also shows how data is transferred into and out of the memory cell matrix (by means of the column I/O and how the active-low chips select (CS) and write enable (WE) lines are connected.

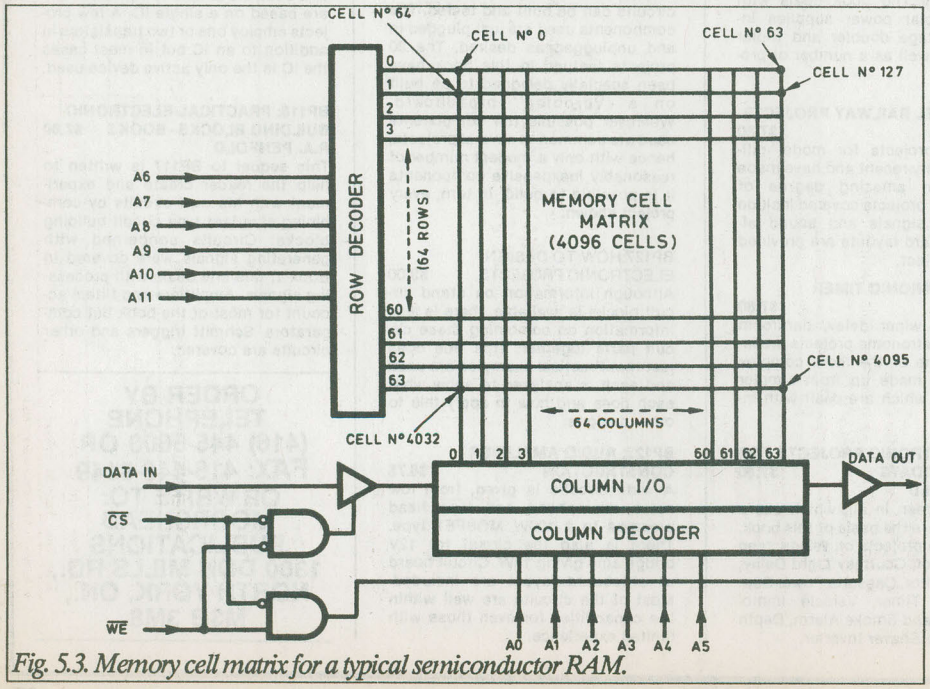


Fig. 5.3. Memory cell matrix for a typical semiconductor RAM.

Problem 5.1

The data sheet for a semiconductor memory device is shown in Fig. 5.4.
(a) State the type number of the device.
(b) State the manufacturer's name.
(c) State the type of device.
(d) State the storage capacity of the device.
(e) State the organization of the memory.
(f) State the number of the pin which is connected to the:
(i) positive supply
(ii) GND or 0V
(iii) least significant address line
(iv) most significant address line
(v) programming supply voltage

Problem 5.2

The data sheet for a semiconductor memory device is shown in Fig. 5.5
(a) State the type number of the device.
(b) State the manufacturer's name.
(c) State the type of device.
(d) State the organization of the memory.
(e) State the number of the pin which is connected to the:
(i) positive supply
(ii) GND or 0V
(iii) least significant address line
(iv) most significant address line
(v) active-low write (WR) line
(iv) address decoding logic

A practical semiconductor read/write memory

Fig. 5.6 shows the basic arrangement of a practical 16K byte semiconductor read/write memory based on eight 6167 CMOS static RAM devices. Each 6167 RAM is organized on the basis of 16384 words x 1 bit and thus eight 6167 devices will be required (one for each data bit). Note that address lines A0 to A13 are common to all of the RAM devices and that the active-low chip select (CS) line is driven from the address decoder (not shown) which uses the two most significant address lines (A15) and (A14) as inputs to determine which of the four 16K byte blocks of memory is actually being used.

Fig. 5.5 See problem 5.2.

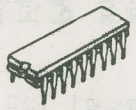
HM6147, HM6147-3
HM6147P, HM6147P-3

4096-word×1-bit High Speed Static CMOS RAM

■FEATURES

- Single 5V Supply and High Density 18 Pin Package
- High Speed: Fast Access Time 55ns/70ns Max.
- Low Power Standby and Low Power Operation, Standby: 100μW typ., Operation: 75mW typ.
- Completely Static Memory — No Clock nor Timing Strobe Required
- No Peak Power–On Current
- No Change of t_{ACS} with Short Chip Deselect Time
- Equal Access and Cycle Time
- Directly TTL Compatible — All Input and Output
- Separate Data Input and Output: Three State Output
- Pin-out Compatible with Intel 2147 NMOS STATIC RAM

HM6147, HM6147-3

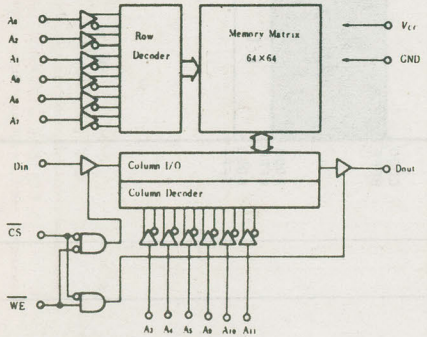


(DG-18)

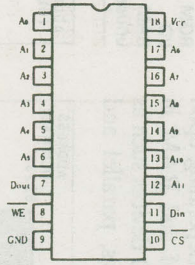
HM6147P, HM6147P-3

(DP-18)

■BLOCK DIAGRAM



■PIN ARRANGEMENT



(Top View)

■ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Voltage on Any Pin relative to GND*	V_T	−0.5 to +7.0	V
Power Dissipation	P_T	1.0	W
Operating Temperature	T_{opr}	0 to +70	°C
Storage Temperature(Ceramic)	T_{stg}	−65 to +150	°C
Storage Temperature(Plastic)	T_{stg}	−55 to +125	°C

* V_{IN} min = −1.0V (Pulse Width ≤ 20ns)

■RECOMMENDED DC OPERATING CONDITIONS (0°C ≤ Ta ≤ 70°C)

Parameter	Symbol	min	typ	max	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
	GND	0	0	0	V
Input High (logic 1) Voltage	V_{IH}	2.2	3.5	6.0	V
Input Low (logic 0) Voltage	V_{IL}	−0.3*	—	0.8	V

* V_{IL} min = −1.0V (Pulse width ≤ 20ns)

Fig. 5.4 See problem 5.1.

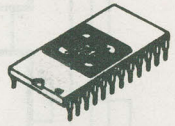
HN462716, HN462716G

2048-word × 8-bit U.V. Erasable and Electrically Programmable Read Only Memory

The HN462716 is a 2048 word by 8 bit erasable and electrically programmable ROMs. This device is packaged in a 24-pin, dual-in-line package with transparent lid. The transparent lid allows the user to expose the chip to ultraviolet light to erase the bit pattern, whereby a new pattern can then be written into the device.

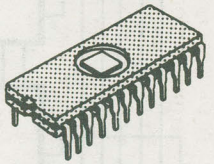
- Single Power Supply ···· +5V ±5%
- Simple Programming ···· Program Voltage: +25V DC
  Programs with One 50ms Pulse
- Static ····· No Clocks Required
- Inputs and Outputs TTL Compatible During Both Read and Program Modes
- Fully Decoded-on Chip Address Decode
- Access Time ····· 450ns Max.
- Low Power Dissipation ·· 555mW Max. Active Power
  161mW Max. Standby Power
- Three State Output ····· OR-Tie Capability
- Interchangeable with Intel 2716

HN462716



(DC-24C)

HN462716G



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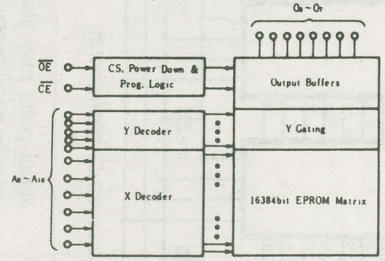
■BLOCK DIAGRAM



■PROGRAMMING OPERATION

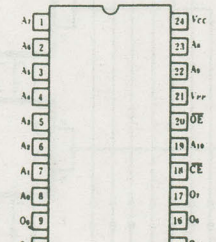
Mode \ Pins	CE (18)	OE (20)	VPP (21)	VCC (24)	Outputs (9~11, 13~17)
Read	V_{IL}	V_{IL}	+5	+5	Dout
Deselect	Don't Care	V_{IH}	+5	+5	High Z
Power Down	V_{IH}	Don't Care	+5	+5	High Z
Program	Pulsed V_{IL} to V_{IH}	V_{IH}	+25	+5	Din
Program Verify	V_{IL}	V_{IL}	+25	+5	Dout
Program Inhibit	V_{IL}	V_{IH}	+25	+5	High Z

■ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Value	Unit
Operating Temperature Range	T_{opr}	0 to +70	°C
Storage Temperature Range	T_{stg}	−65 to +125	°C
All Input and Output Voltages*	V_T	−0.3 to +7	V
V_{PP} Supply Voltage*	V_{PP}	−0.3 to +28	V

* With respect to Ground

■PIN ARRANGEMENT



(Top View)

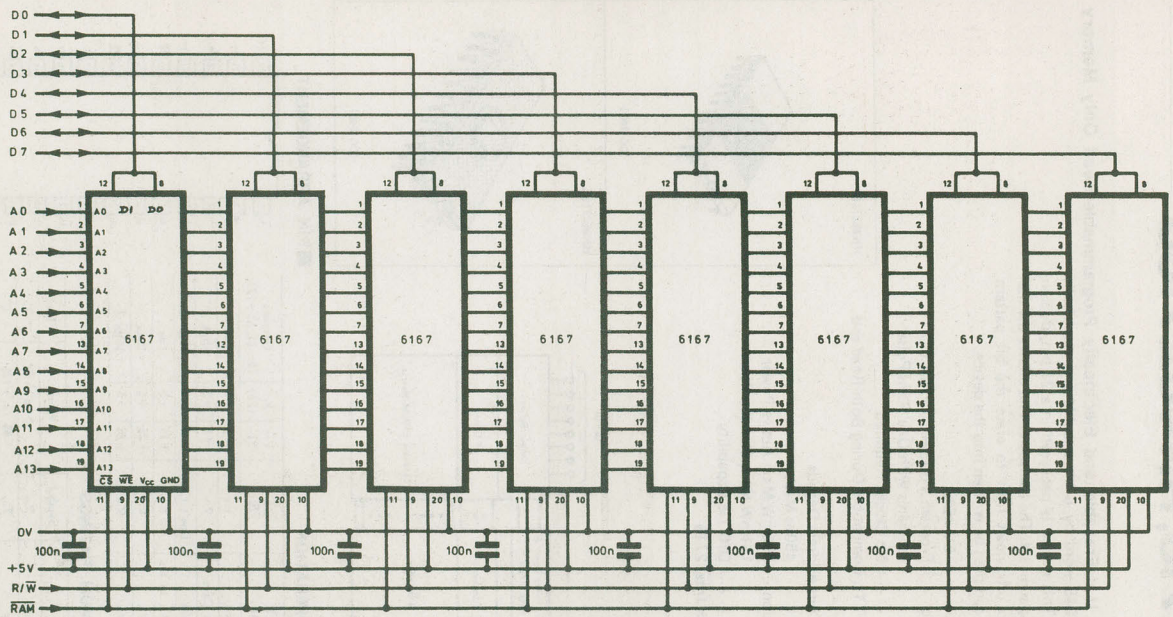


Fig. 5.6. Apractical 16K byte semiconductor read/write memory.

provide decoupling of the +5V supply rail.

Memory Maps

Each location in semiconductor ROM and RAM must have its own unique address. At each address a byte (comprising eight bits) is stored. Each ROM, RAM (or bank of RAM devices) accounts for a particular block of memory, its size depending upon the capacity of the ROM and RAM in question. Furthermore, I/O devices such as keyboards, VDU displays, parallel and serial ports may also be memory mapped into the microprocessor's address space. As an example, a simple home computer may have 12K byte ROM, 4K bytes reserved for I/O, and 16K bytes of RAM allocated to addresses shown in the following table:

Device	Capacity	Address	Range
	(bytes)	Hexadecimal	Decimal
ROM	12K	0000-2FFF	0-12287
I/O	4K	3000-3FFF	12288-16383
RAM	16K	4000-7FFF	16384-32767
unused	32K	8000-FFFF	32768-65535

A more meaningful way of expressing the allocation of addresses to RAM, ROM and I/O is by means of a memory map along the lines of that shown in Fig. 5.7. Note that the map is drawn to scale with addresses ranging from 0000H (at the bottom) to FFFFH (at the top) and that not all of the address space is populated (the upper 32K bytes of memory is unused and any attempt to read or write to this area would be unproductive).

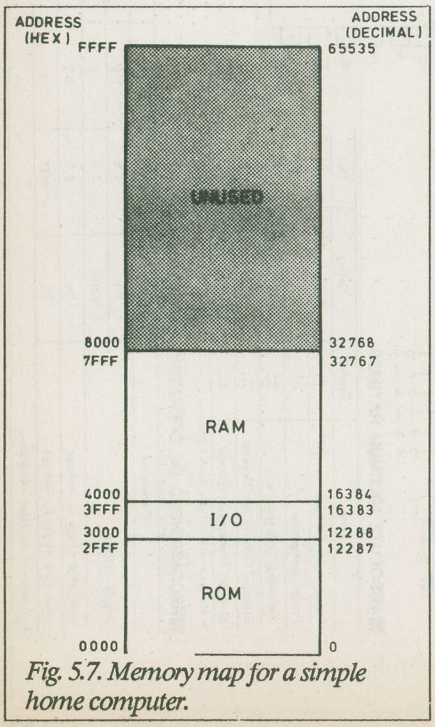


Fig. 5.7. Memory map for a simple home computer.

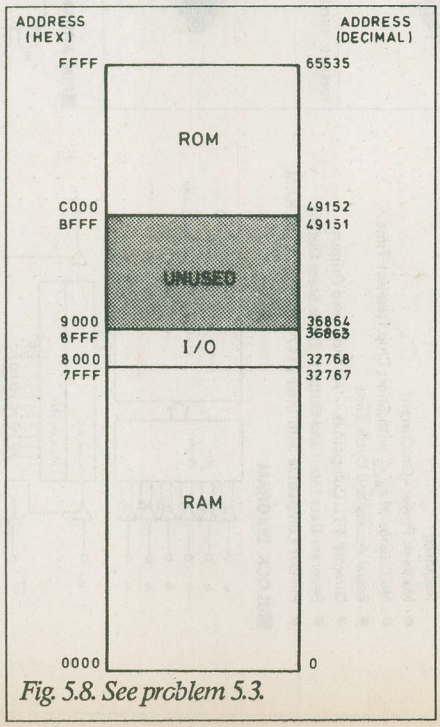


Fig. 5.8. See problem 5.3.

Problem 5.3

Fig. 5.8 shows the memory map for a microprocessor based system.

(a) State the total amount of ROM available.

(b) State the total amount of RAM available.

(c) If the ROM space is populated by devices each organized on the basis of 4096 words of 8 bits, how may ROM device will be present?

(d) If the RAM space is populated by devices each organized on the basis of 16384 words of 4 bits, how many RAM devices will be present?

(e) What is present at each of th of the following memory addresses?

(i) 007F hexadecimal

(ii) 32767 hexadecimal

(iii) 8001 hexadecimal

(iv) 49150 decimal

(v) 1111111110101000 binary

Glossary For Part Five

Address decoder

A decoder which selects a specific address

Continued on page 54

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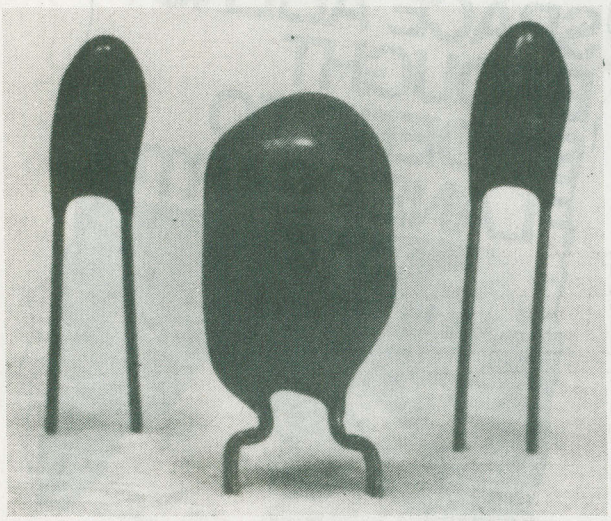

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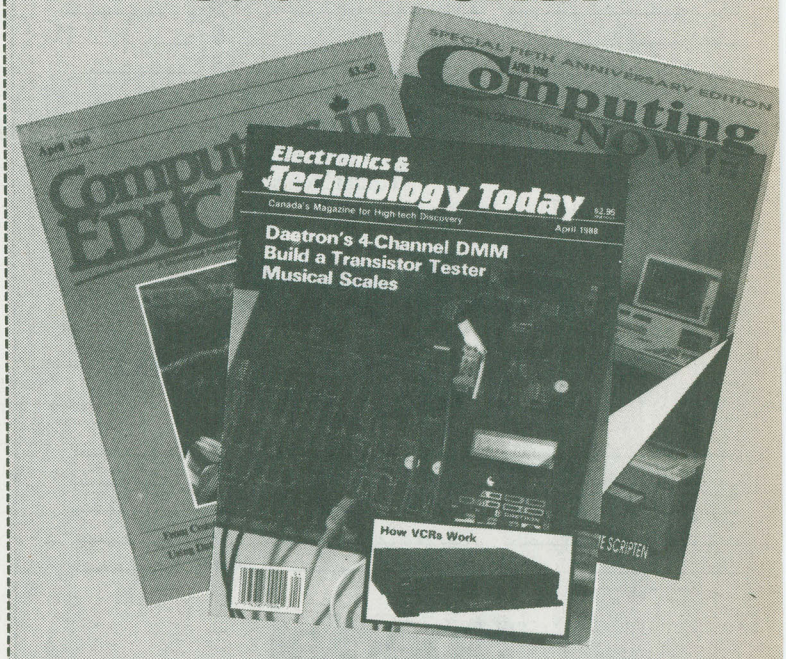

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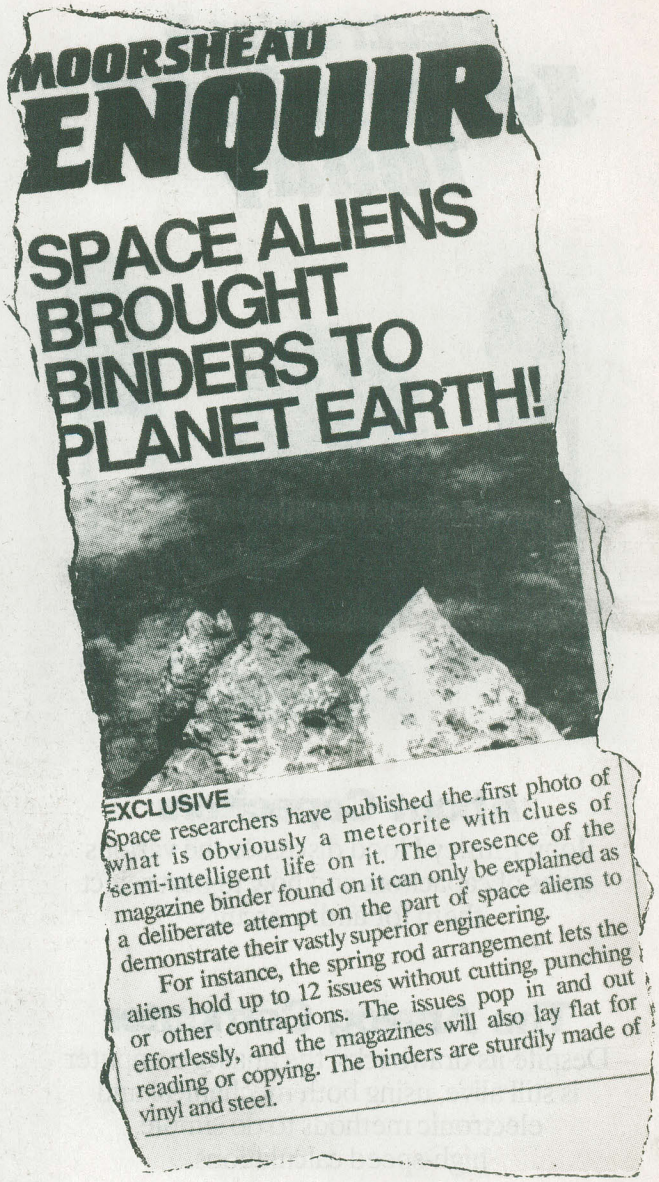

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The Portable Office

Cellular service plus miniaturized office equipment equals the office in a car

BILL MARKWICK

Wayne Silver of CellStar Corporation with some of the many pieces of equipment in their demonstrator van. On the left, a Toshiba laptop computer is connected to a cellular interface, along with a FAX machine, which is in the cabinet drawer just below the computer. At the front of the vehicle is a standard cellular phone with a cordless extension handset. It can also be used handsfree, or with the headset shown.

In our last issue, we detailed the basics of the cellular telephone, that amazing work of microchip technology that allows you to stay in contact with just about anywhere. Since the cellular line, in effect, works like any telephone line, the next obvious step was to add a modem and start computing, a step that was made possible by the popular laptop computers. Now there are facsimile machines available that are small and battery-powered, letting the user transmit and receive paperwork to and from any FAX number.

Computer Data

If you own a laptop computer, or if you plan to get one from the cellular phone companies, you'll need one with either a built-in or external modem to convert the data to the tones required for transmission over the telephone lines. An example of a modem that is specifically made for cellular service is the Morrison & Dempsey AB2 series, supplied to the cellular companies by CellStar of Mississauga. The AB2 features the Hayes compatible command set, and the MNP error-correction method. This last is an important feature; although the cellular service is very good technically, it's still a radio transmission and susceptible to various forms of interference, plus the fact that the main cellular computer switches the mobile phone from one transmitter to another as the car moves through the various cells (the "handoff"). In order to prevent loss or corruption of data, it's necessary to use an error-correction protocol that checks your bits and bytes for signs of problems. The general word is that yes, you can perform data transmission while the vehicle is moving, but if problems arise, it's best to do the transmission while you're parked.

The AB2 series operate at 300 or 1200 baud in full duplex asynchronous mode. In general, 1200 baud is fast enough for general use with all but the largest of files; it'll rapidly list pages of data. Electronic mail is another option available with the AB2. The unattended modem will automatically answer an incoming call and take a message whether the computer is in the vehicle or not. Later, the computer is connected and the message retrieved. This eliminates having to leave the computer in the car.

If you already have a laptop with a modem, then you'll need some sort of connector to feed the data into the cellular phone, and various hookups can be provided by the cellular companies or third-party suppliers. For instance, Radio Shack sells a unit for their phones for $99.95 that not only allows a computer connection, but gives you hands-free

OTHER LAB EQUIPMENT JUST DOESN'T MEASURE UP

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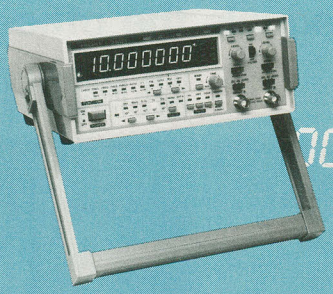

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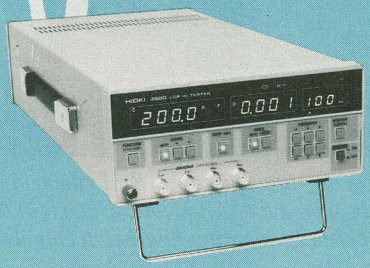

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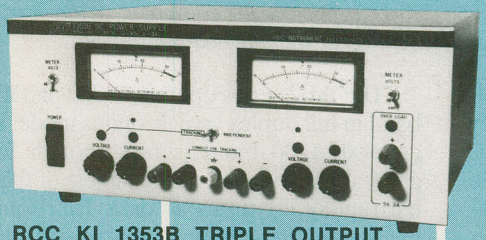

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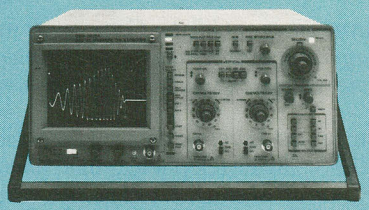

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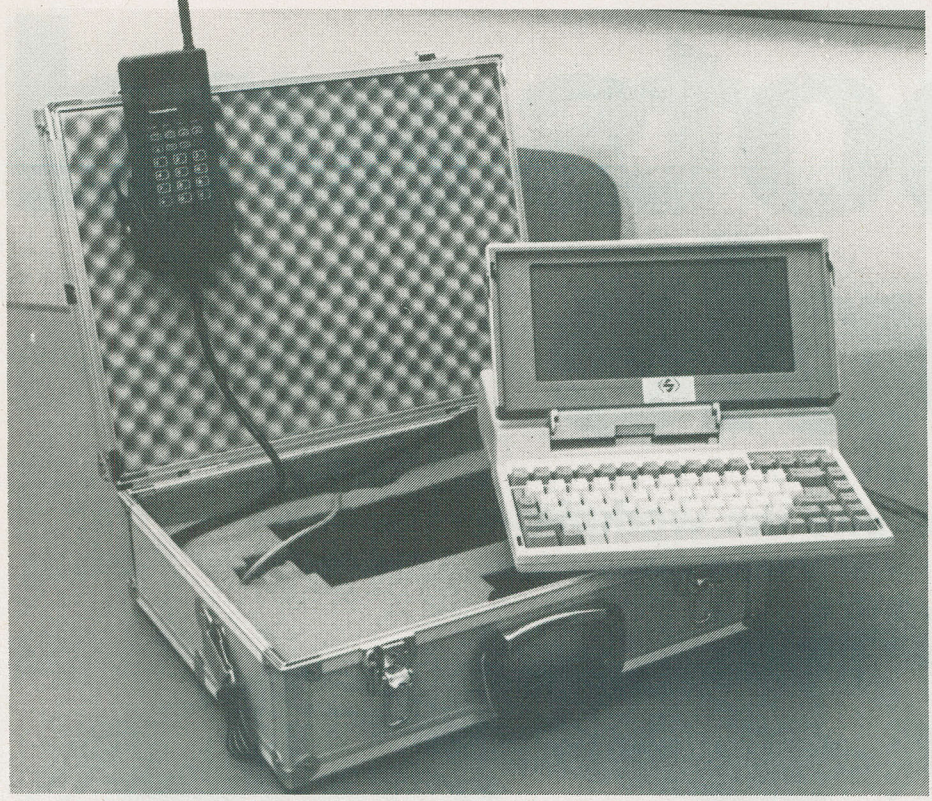


The office in a briefcase from CellStar Corporation. The tiny Technophone cellular phone (which works on its own as well) is connected to a modem, battery pack and a laptop computer and/or a FAX machine (not shown).

operation of the telephone as well (the 17-501 or 17-601 Handsfree/Data Interface).

Special Hookups

Suppose you would like to use a normal telephone (a POT – plain old telephone) with your cellular service, or connect an answering machine, or even transmit slow-scan video. The problem here is that the connection to the cellular transmitter lacks the standard characteristics of the telephone company landline, particularly the DC voltages required to operate standard telephones. This can be solved with a unit such as the Morrison & Dempsey AB1X cellular interface, which provides all the required operating parameters for telephones, answering machines, FAX machines, and so on. You can connect a cordless phone, for instance, should you want to be able to move away from the vehicle without carrying a heavy transportable. There are many other possibilities, such as security alarm connections, marine installations, emergency systems and many others.

There are even units available for the transmission of medical data. The ECG1, again from Morrison and Dempsey, is designed to interface medical electrocardiogram equipment to cellular phones, an alternative to radio channels. It's also compatible with other commercially available medical equipment.

The FAX

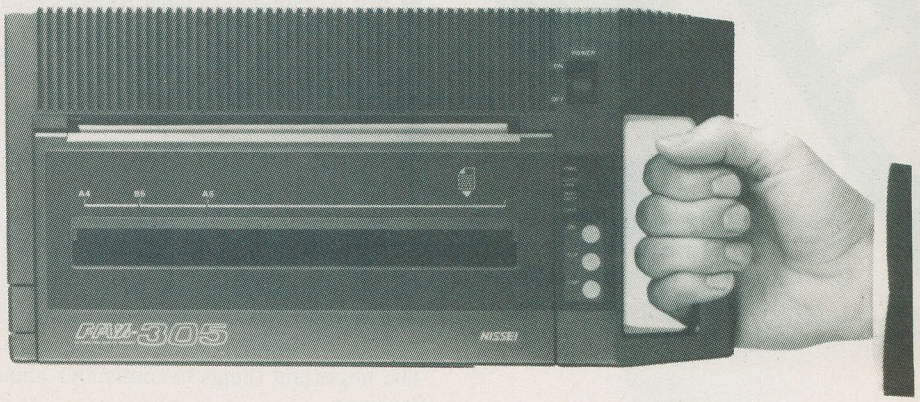
It's of interest to note that as this article was being written, CN/CP Telecommunications announced layoffs due to the decline of their Telex service, a decline which they blame directly on the popularity of the FAX machine. Almost every business office has one now, for instant transmission or reception of documents. The facsimile machines supplied by CellStar aren't even as big as a city phone book, and fit conveniently into any car or van. In fact, with the tiny Technophone, a battery pack, a computer, a modem and your FAX, you have all the office equipment you need, and it's small and light enough to easily carry between the vehicle and a hotel room, where you can spend a pleasant evening seeing how your stocks are doing...

Another FAX unit is the Nissei FAX-305, featured by Cantel and also available from third-party suppliers. The 305 is approximately 7 by 14 by 3 inches and weighs just 8.6 pounds. It's also available with NiCad rechargeable batteries so that it can be used anywhere; it doesn't require connection to the power line. The batteries provide 25 pages per charge. It can also be used as a photocopier.

Taking It With You

The equipment doesn't have to be tied to the vehicle. It's all small and light enough to be easily transportable to another office or room. It becomes possible for a real estate agent with a laptop computer to access property listings, or for a broker to obtain and register quotes, or journalists to file stories. The computer and FAX machine allows a sales representative to provide on-the-spot quotations to customers. Cellular service has made it possible to have any of the features of a landline just about anywhere.

Sources: contact your local Bell Cellular or Cantel office for most of the services described above. Much of the information on special applications was supplied by the CellStar Corporation, 3040 Universal Drive, Mississauga, Ontario L4X 2C8, (416) 629-3737. ■



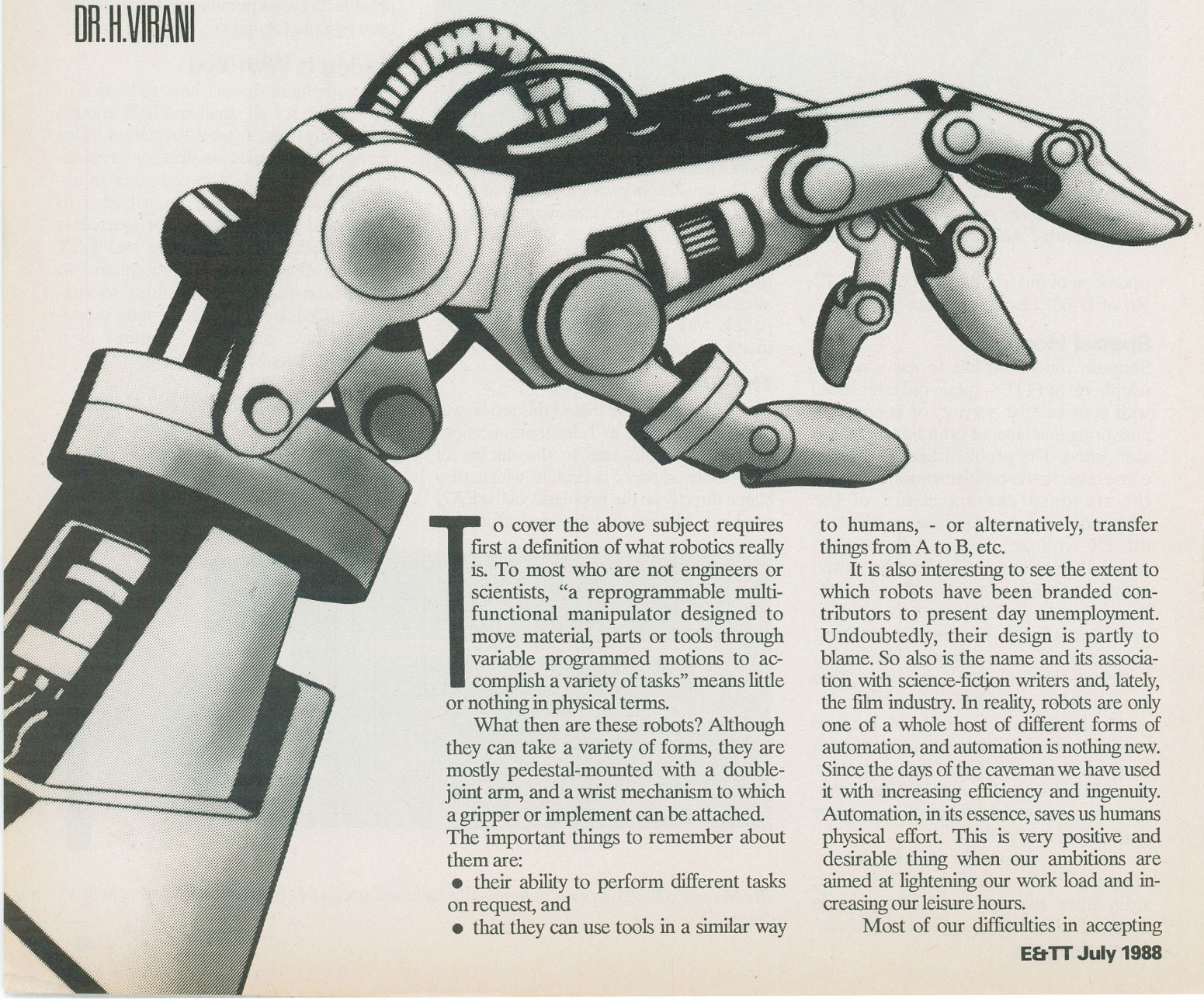
The Nissei FAX-305, a portable facsimile machine that can produce 25 copies on one battery charge.

FEATURE

Robots and People

On integrating robotics into the workplace.

DR. H. VIRANI



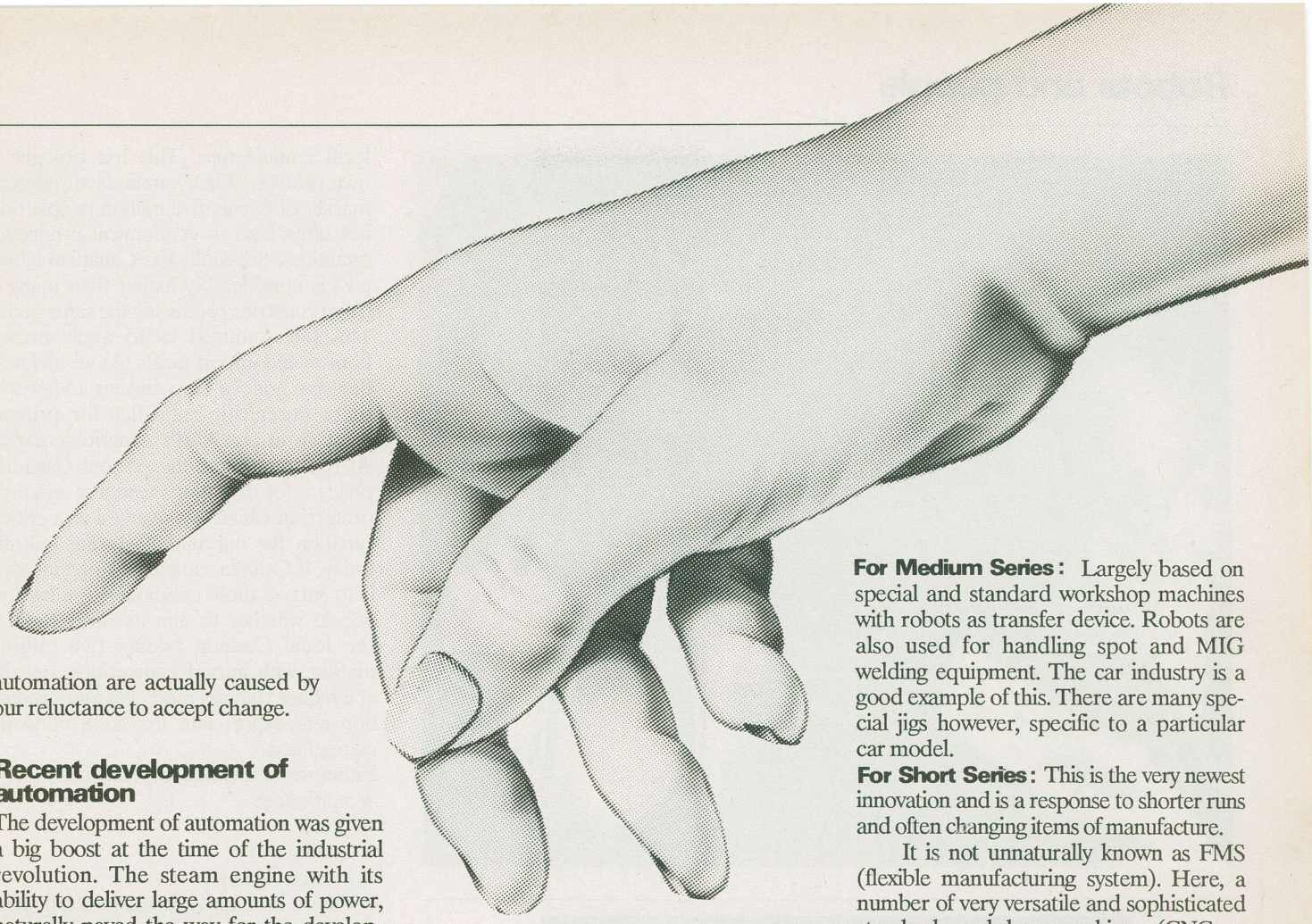
To cover the above subject requires first a definition of what robotics really is. To most who are not engineers or scientists, "a reprogrammable multi-functional manipulator designed to move material, parts or tools through variable programmed motions to accomplish a variety of tasks" means little or nothing in physical terms.

What then are these robots? Although they can take a variety of forms, they are mostly pedestal-mounted with a double-joint arm, and a wrist mechanism to which a gripper or implement can be attached. The important things to remember about them are:

- their ability to perform different tasks on request, and
- that they can use tools in a similar way to humans, - or alternatively, transfer things from A to B, etc.

It is also interesting to see the extent to which robots have been branded contributors to present day unemployment. Undoubtedly, their design is partly to blame. So also is the name and its association with science-fiction writers and, lately, the film industry. In reality, robots are only one of a whole host of different forms of automation, and automation is nothing new. Since the days of the caveman we have used it with increasing efficiency and ingenuity. Automation, in its essence, saves us humans physical effort. This is very positive and desirable thing when our ambitions are aimed at lightening our work load and increasing our leisure hours.

Most of our difficulties in accepting



automation are actually caused by our reluctance to accept change.

Recent development of automation

The development of automation was given a big boost at the time of the industrial revolution. The steam engine with its ability to deliver large amounts of power, naturally paved the way for the development of many and varied types of machines which would use that power. The internal combustion engine and petrol brought us the motor car, and through Henry Ford, the production line method of manufacturing.

The production line was revolutionary in many ways, not the least that it could utilize non-skilled labour. Jobs were broken down into elements requiring only a few hours training and no trade background.

The employee learned by performing the same task repeatedly, but having once learnt, the job remained the same. This has contributed to very efficient manufacturing at the cost of a marked decline in the number of trades people in the work force. As it was now possible for industry to recruit the cheapest labour available for what must be very undesirable and unrewarding jobs, the union movement grew accordingly to protect the wages, safety and job security of their members.

Because a production line must function along its entire length, it was natural that those unions became extremely powerful, and because of the polarization of interests between unions and management, the relationship was more often than not one of confrontation.

Management's hopes that a production line would produce a stream of identical products was seldom fulfilled. In spite of jobs being broken down into small elements there remains humans variation and human error. It is very difficult for the individual who performs and anonymous and trivial tasks to appreciate that he or she is also an essential and variable ingredient of the beautiful product emerging from the other end of the line.

This, often complete, disinterest in the job creates mistakes, bad workmanship and necessitates numerous inspection stations with expensive gauges and time wasted to ensure an acceptable final product. It is therefore, no coincidence that continued automation has been most evident in this particular form of manufacture.

Automation of the production line has taken three different paths:

For Very Large Series : A predominance of special-built stations and transfer mechanisms for the product. Expensive to design and construct, but highly automated. The complete line is often written-off at the end of the production run. (Example: home electronics manufacture).

For Medium Series: Largely based on special and standard workshop machines with robots as transfer device. Robots are also used for handling spot and MIG welding equipment. The car industry is a good example of this. There are many special jigs however, specific to a particular car model.

For Short Series: This is the very newest innovation and is a response to shorter runs and often changing items of manufacture.

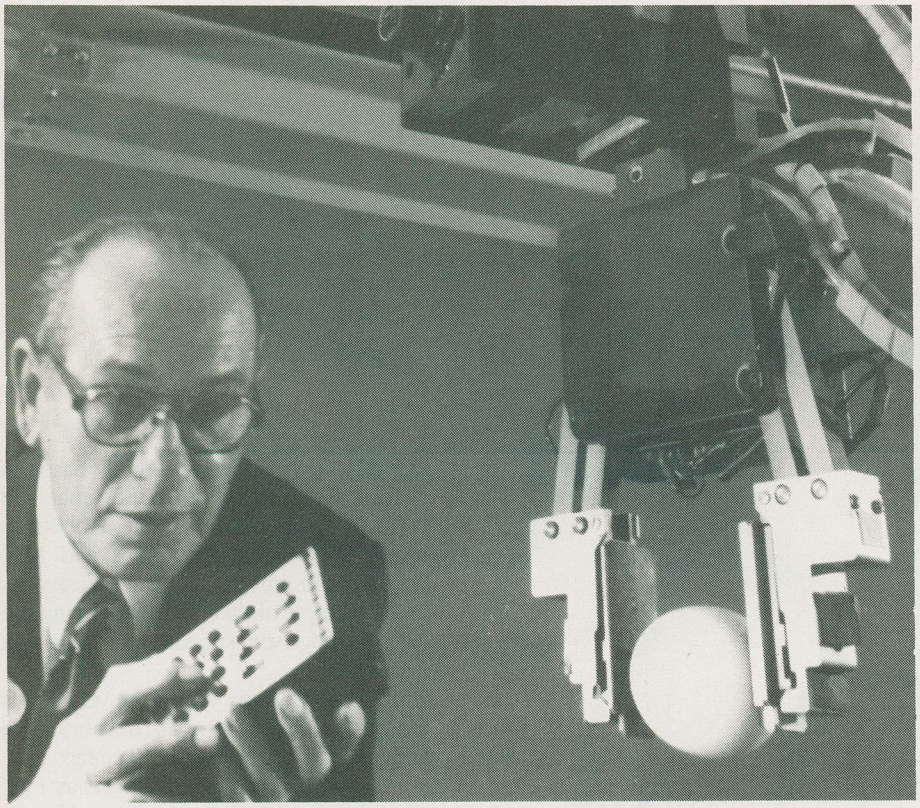
It is not unnaturally known as FMS (flexible manufacturing system). Here, a number of very versatile and sophisticated standard workshop machines (CNC or computer numerically controlled) combine to manufacture a wide variety of articles. Conveyors automatic guided vehicles (AGV) and robots are used to transfer components from one machine to the next. In contract to the production line where components went from station 1 to 2 to 3 etc., the FMS cell can transfer the same component between different stations for machining at random.

Robotics and the Canadian scene

We have approximately 30 to 40 robots in Canada, and it may seem that their influence on us is very marginal. The big influence however, is the number of robots we do not have. Let us examine what is happening around us. We are living in a competitive world.

Because Canada had a good climate for growing things, the world automatically bought from us. Then came subsidies in other countries, which put pressure on us to produce our primary products as cheaply as possible.

As far as manufactured goods were concerned, there was a time when we used to import most of them. However, since the tightening of the economy, we have been forced to turn more and more to



local manufacture. This has brought its own problem. Firstly, manufacturing for a market of twenty five million people does not often lead to economical production quantities. Secondly, the Canadian labour cost is considerably higher than many of those countries producing the same goods. This then induced us to apply protectionism and import tariffs. As we all know, this has gone a step further today with quite unrealistic subsidies for primary produce in our North American market. At the same time, the present Canadian policy is for dropping incentives and tariff protection which has resulted in a critical situation for our manufacturing industry today. If Canada's manufacturing industry is to survive these conditions, it must first decide whether to aim its production at the local Canada twenty five million market, with import competition, or, aim at a higher volume, more efficient production and export into the teeth of world competition.

Either way it means competing on:

- marketing
- price
- quality and
- service backup

While we have tariffs it was generally possible to carry the costs of these services on the turnover of the local market. However, now that outside competition has been allowed in, the situation is very different. In industries it must either learn to survive on a much smaller share of the local market or meet the competition on its own grounds. That is, produce competitively priced market oriented, high quality goods.

Impossible? (yes, under present circumstances). But here is where automation and robotics will come to our rescue.

Competitive Price

To do this we must overcome:

- High wage costs
- High social costs
- High inflation
- High interest rates
- Low productivity

Market-oriented products

The factors against these developing are:

- Market investigating cost
- Product cycle time
- Design costs
- Tool production costs
- Set-up time

High quality

Factors against this include:

- Human variations
- Human error

Although this looks a very formidable list, it

can be overcome by applying new manufacturing techniques including many exciting tools which are presently becoming available.

Our competitors in North America are using them. If we are to survive, we must follow suit.

Let's look more closely at robots.

They are versatile, fast, accurate, untiring, easily programmed machines that quality for tax rebate due to depreciation.

Good quality ones will last a long time too. The first one we made worked round-the-clock 365 days a year for 10 years with only a couple of short breaks. They need no wages, car park, toilet or meal breaks and have no objections to noise or hostile working conditions — quite an ideal servant.

Because they are so accurate and repeat their pogrom endlessly with the same precision, they deliver a consistent and high quality product. Their working speed is generally faster than a person, and because of the absence of the breaks and pauses, have a much higher output at the end of the shift. On a three shift basis, the robot is supreme.

With all the wonderful advantages a robot brings, why are we not using them by dozens? Our reluctance to change, our fear of job loss, and our fear of industrial disruption are probably the main reasons, but there are others. Let us look at the introduction of a robot into a factory and examine its effect on the groups of staff most influenced by its introduction.

1. Management

Driven by the responsibility to make money, the robot can be an enigma.

"It will work around the clock for no wages"

"Yes, it will cost a lot of money"

"It will cut down on our scrap and do a consistent high quality job"

"Yes, but the union will go on strike"

"With different programs we can change production runs quickly and respond quicker to the market"

"We will have to pay people higher wages to look after it"

2. The Shop-floor staff

What has been feared most has happened. Rumour has it that a robot is to be installed in the factory. Everyone knows that they can do a human's job — quite a few, in fact. There will be a job lost. Whose and how many? Will management stop at one robot or will they put in more and more, with a corresponding worsening of the situation? Should they make sure that the first is stopped to prevent precedence?

3. The forgotten group: Middle Management

The worker-management confrontation is so common these days that few people realize that this group is also profoundly affected by the introduction of a robot. Because they are a smaller group the effect is correspondingly larger on the individual. Here we have, for example, the foreman who has worked his way up through the ranks, a master tradesman now with the responsibility for both a number of workers and also the standard of their output.

A robot is always at work, never has social demands, does not have to be supervised and quite severely undermines the authority of this person. One robot may not make much difference but several in one department can be very disruptive. New disciplines must be learned, and one isn't as young as one used to be. Programming methods, language working envelopes, interfaces with other machines, etc, etc.

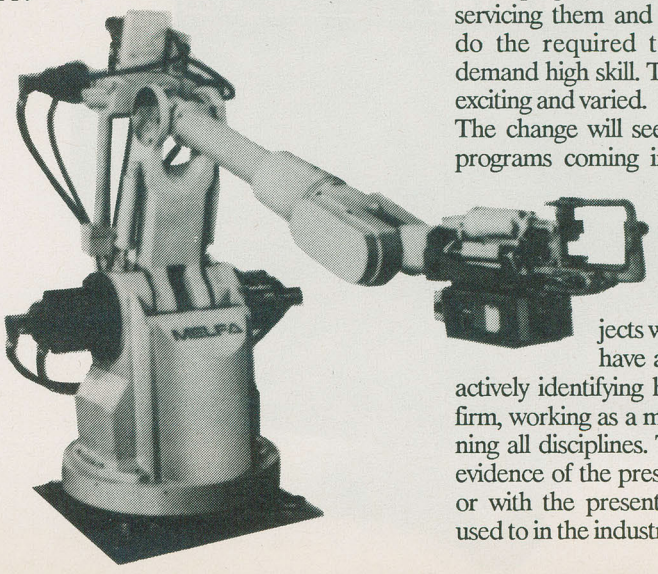
The Solution

As can be seen, there are plenty of potential crises, and there is plenty of room for misunderstandings between interested parties. It is therefore, essential that an open and above all frank exchange of ideas takes place at the conception stage. Management have legitimate reasons for automating.

Improved quality, productivity, a more secure way of ensuring that the business stays in business. Workers will be displaced from some jobs, but more often than not these jobs are the dirty, monotonous dangerous, undesirable ones that have created absenteeism for years and have cost management dearly.

After everyone is informed, no one is unhappy that a robot takes over the undesirable jobs. It is very important, however, that people do not lose jobs as result. With a little planning and forethought, all can benefit in the end. Because of a robot usually works faster, more product is handled. This in turn, requires more staff elsewhere to deal with the increase production. Also, someone, preferably more than one, must be capable of programming and operating the robot.

An interesting situation exists in Japan where the majority of robots are installed in very small firms, often in a garage. They have been bought for a song from the larger manufacturers who have replaced them with the latest robot models in order to keep up with the world. Often these "back yard" firms are a husband and wife team making small components for larger industries. When installing a robot it is really worthwhile maintaining good communications with the people who know the job concerned. It is surprising how many practical ideas can come from the shop floor.



The factory and the future

Automation stretching from the TV or monitor screen used by the designer, right down to the workshop machines, robots and AGV'S transporting the goods through the factory will be common. Everything will be linked to a central computer and coordinated by it. Raw material will go in one end and finished product will emerge from the other.

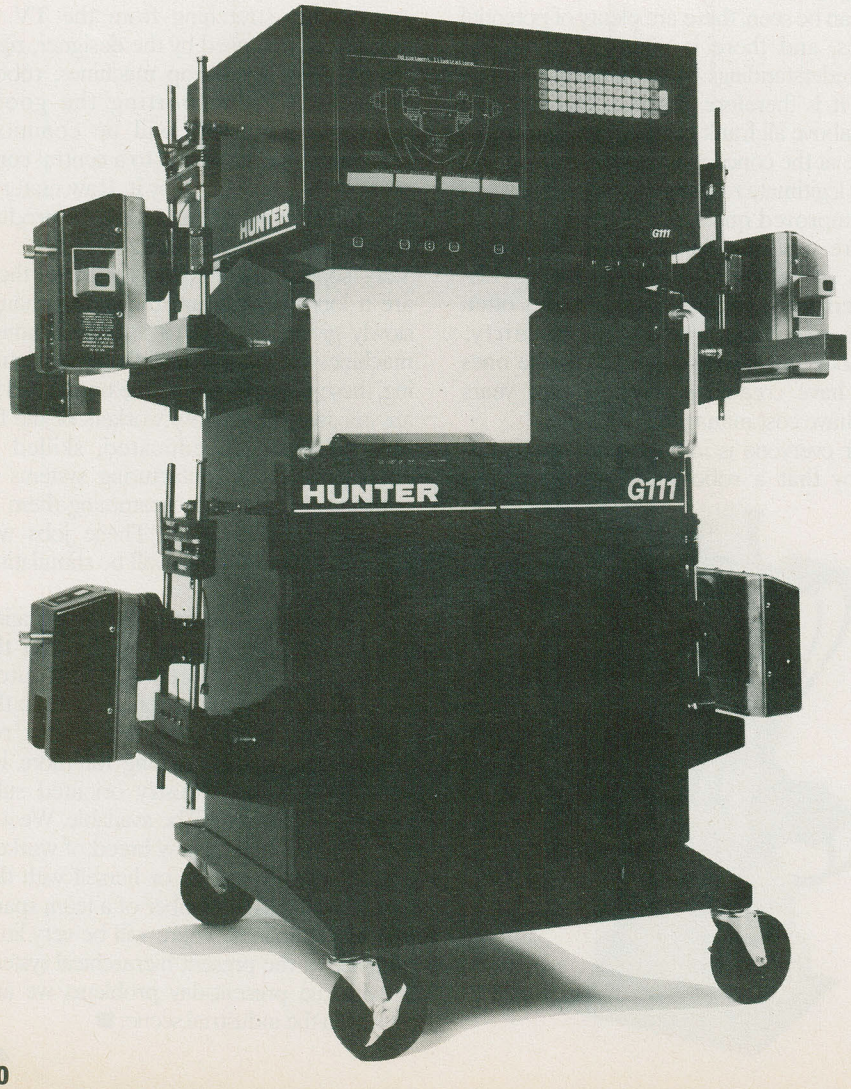
Very sophisticated systems such as these are a long way off and things will change slowly giving us time to adjust. Although machines will be doing all the manufacturing, these factories will not be unmanned by any means. The factory workers of the future will be well educated, skilled in developing the manufacturing systems in servicing them and programming them to do the required tasks. These jobs will demand high skill. They will be stimulating, exciting and varied.

The change will see growing re-education programs coming into place, both in the technical institutes, universities and in the factories where re-training for more industry oriented subjects will be available. We will have a new breed of worker, actively identifying him or herself with the firm, working as a member of a team spanning all disciplines. There will be very little evidence of the present hierarchical system or with the present-day problems we are used to in the industrial scene. ■

Computerized Wheel Alignment Equipment

Microprocessors improve the standard alignment technology.

RON C. JOHNSON, C.E.T.



One of these days someone will invent the antigravity generator. Or a lighter than air automobile. May be even a teleportation device that will make Detroit obsolete (not to mention Japan). When any of these wonders come along we can take the tires, wheels, suspension and steering system now used in our vehicles and kiss them goodbye.

Until then we are trapped in the real, mundane world of potholes, curbs in the wrong places, and fender-benders which do their best to change the relationship between your wheels and the car to which they are attached. Let's take a look at the basics of wheel alignment and how modern technology is used to assist the alignment technician put your car on the straight and narrow.

Why Toe the Align?

Not so many years ago you could take a tape measure and do a fairly close toe adjustment by setting your steering wheel straight and measuring across the front tires. If you took the vehicle into the shop, the mechanic would drive the vehicle over a pit and do much the same thing. He would also use a complicated set of mirrors and light beams to measure and set the camber and caster. It took a while, but for those vehicles, it did the basic job.

Today things are a bit more complex. With more and more vehicles being downsized and built with unibody construction, collisions can cause shifts in the overall geometry of the vehicle. It is even said that, on the very small cars, the weight of five passengers can distort the alignment. A great percentage of new cars are now front wheel drive. Front wheel drive creates a completely different interaction between the road and the front tires, causing different wear conditions. With new steering mechanisms and strut suspensions being used the diagnosis of front end problems becomes more complex.

Add to all of this the fact that the automobile owner wants good handling and tire life and you have created a market for the computer wheel alignment system.

Basic Concepts

Just point the wheels straight and let's go, right? Wrong. Here, for the uninitiated, is a brief description of what's measured on any good aligner:

Camber: This is the angle, in degrees, of the inward or outward tilt of the wheel, from the vertical. it can be

measured on both the front and back wheel. Positive camber is measured when the top of the wheel leans away from the car; negative when it leans in. (See Fig. 1.) Camber, when set to vehicle specifications, is used to counteract road forces on the wheel. If set incorrectly, it can cause tire wear and/or a pull one way or the other on the steering wheel.

CASTER: Fig.2 shows a side view of a front suspension system. Whether the vehicle uses a Short-Long Arm suspension or some kind of strut, there is a steering axis on which the wheel pivots. It is measured in degrees from the vertical and is described as the forward or rearward tilt of the steering axis. A rearward tilt is positive while a forward tilt is negative. Caster affects handling. More positive caster will cause the steering to return to centre more easily after a turn and tend to stay there reducing wander. The drawback to this is the tendency for road noise and shock to travel more directly through the steering mechanism to the steering wheel. If one wheel has more positive caster than the other, the car will have a tendency to pull to the side with the least positive caster.

TOE: Toe would seem to be the most straightforward concept in wheel alignment, but the requirements of today's market make it a little more interesting. Basically, toe is a measurement, in inches traditionally (although this is changing to degrees), of the angle of each wheel with respect to the centre line of the vehicle, when viewed from above. (See Fig. 3) This can also be measured on the rear wheels. Positive toe readings come from the front of the wheels pointing inwards, while negative toe indicates the front of the wheels point outwards. Again toe adjustments are needed to counteract road forces against the wheels and must be set so that when the steering wheel is straight the vehicle will drive straight down the road with no pull either way. An incorrect toe adjustment will cause pull, crooked steering wheels and excessive tire wear.

Now we get to the interesting part of wheel alignment. Remember the old Chevy truck you saw roaring down the road with its rear end trying to go one way and the front the other. It was dog tracking. If we took it in and set the camber, caster and toe on the front (with reference to the centre line of the vehicle) would it drive straight? Probably not. The reason is that somewhere along the line the rear end of the vehicle has changed (possibly due to an accident). If we measured the rear toe we would find the two readings unequal. If we took the readings and did some calculations on them we could draw a line down the vehicle which would indicate which direction the rear wheels are pushing the vehicle. This is called the thrust line of the vehicle. If everything is perfect the thrust line will be the same as the centre line. However, often it isn't (see Fig. 4.)

So now we have a choice. either we get a big 'calibrating hammer' and straighten out the rear end or we adjust the front to compensate for it. On the newer front wheel drive vehicles they have included adjustments to the rear suspensions to correct for problems with rear camber and toe. In some cases aftermarket add- ons will do the job. Whichever way it is done, the alignment technician can correct for the problem so that the vehicle drives straight with a straight steering wheel. When the front is adjusted to compensate for the thrust angle this is called a 4 wheel thrust alignment. When the rear is adjusted until the thrust angle matches the center line, it is called a true 4-wheel alignment.

SAI and INCLUDED ANGLE: These two measurements, shown in Fig. 6, are mainly used as diagnostics of the mechanical state of the front end. They can be especially useful after a collision to determine whether damage has been done to the suspension and steering. SAI (Steering Axis Inclination) is the angle between the steering axis and the vertical. This figure plus the camber measurement make up the Included angle.

From the Wheel to the Computer

Now that we've seen what we want to measure and adjust we'll look at how we do the measurement and adjustment. Electronics are not new to the wheel alignment business but the addition of computer technology has increased accuracy and decreased the time element in the procedure. All of this improves efficiency and therefore profits for the front end shop. The latest generation of computerized wheel alignment systems usually consists of the following:

- The main console which houses the computer, video monitor, printer and operator keyboard.
- Four wheel sensors on some kind of wheel adapter used to attach the sensor to the rim of the vehicle's wheels.
- An optional remote indicator to facilitate adjustments at the rear of the vehicle.

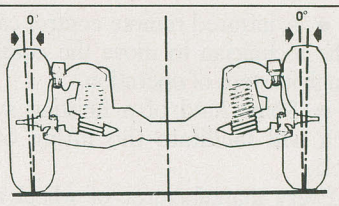


Fig. 1. Front view of a typical suspension system showing camber.

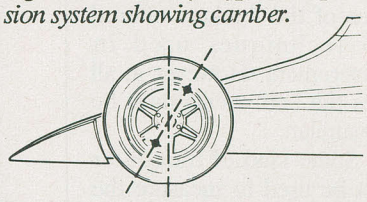


Fig. 2. Side view showing positive caster.

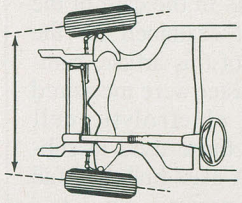


Fig. 3. Top view of a vehicle showing toe-in.

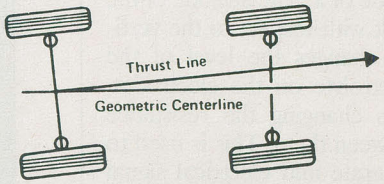


Fig. 4. A vehicle with a thrust line, off-centre, which is caused by rear wheel misalignment.

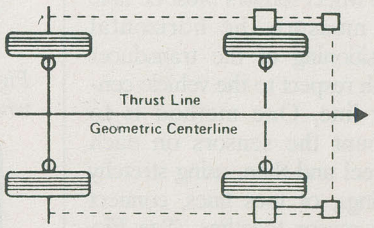


Fig. 5. When the vehicle as had a four-wheel alignment, thrust and centre line are the same.

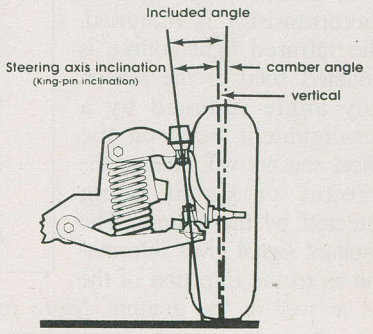


Fig. 6. Typical short-long arm suspension showing SAI and Included angle.

Computerized Wheel Alignment Equipment

- A infrared remote control carried by the technician to move the computer through its steps of operation.
- Some kind of a hoisting system which will facilitate the lifting of the vehicle.

Every manufacturer of wheel alignment equipment varies in terms of the features offered and techniques used in measurement. However in all cases the end results must be very similar.

Some kind of transducer must be used to measure the sensor's attitude with respect the vertical. In the case of the equipment examined for the purposes of this article, camber and caster were measured using an electrolytic cell similar to those used in submarines. A glass bulb half full of an electrolytic fluid has several electrodes positioned inside of it. The attitude of the built with respect to the vertical changes the level of the electrolyte on the electrodes, thus changing the resistance between them. This is used to generate and electrical signal indicating camber and caster, depending on the direction of the tilt.

All wheel sensors must be able to measure the horizontal positioning of the transducer with respect to the vehicle center line. One method is to mount the sensors on each wheel and then, using stretchy strings, or toes lines, connect the sensor together. (See Fig. 5.) The toe lines are actually connected to a mechanical pivot assembly on which a phototransistor is mounted. The infrared light source is mounted solid to the sensor. Any angle induced by a misalignment between the wheel sensors will change the amount of signal being detected by the source. The resultant signal gives information as to the direction of the toe as well as the amount. More recent technology uses infrared beams from one wheel sensor to another, eliminating the toe lines. The same principal applies as with the toe lines sensors but a greater distance.

Once the measurement signals are obtained in the wheel sensors they are converted to digital information which can be sent back to the main console. Each wheel sensor has its own microcontroller on board and even stores its own calibration constants. The information, in digital form, is sent to the main computer via a serial data bus.

The main computer console consists of the computer electronics, a monitor, a printer and an operator keyboard. The console receives the data from the wheel sensors and displays it on screen. It also stores specifications on a wide range of vehicles for comparisons with measured results. The technician steps though the alignment procedure, (using the keyboard or a handheld infrared remote), according to prompts given on screen. The specifications are compared with measured results using graphics to facilitate adjustment to the vehicle. The graphics and digital information is also displayed on a remote indicator which can be carried closer to where the technician is adjusting the vehicle. If the technician is not familiar with how to adjust a particular vehicle he can call up 'help' screens which show graphically where the adjustments are made. Text also describes how to do the adjustments. When the alignment is complete the computer prints a copy of the results for the customer or for shop records.

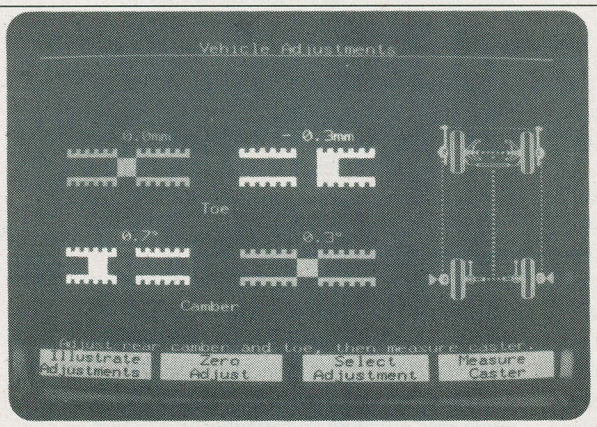


Fig. 7. Adjustment screen used by technician to set camber and toe.

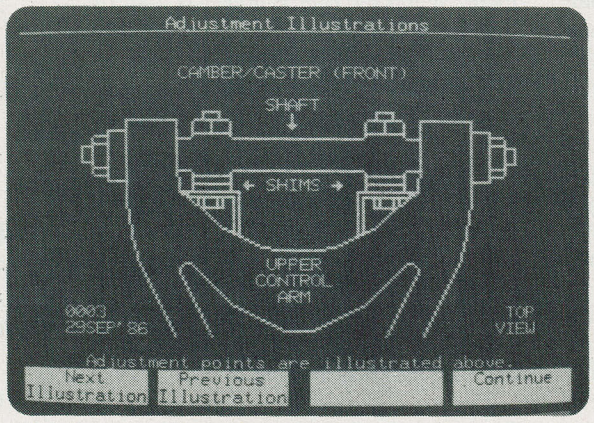


Fig. 8. Adjustment illustration used to show technician how and where to make adjustment.

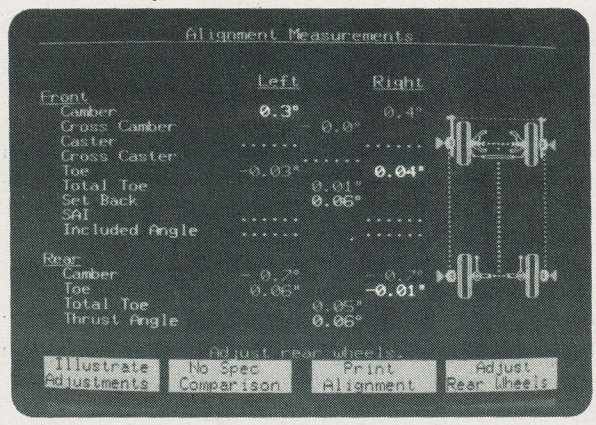


Fig. 9. Alignment measurement screen displays measured data.

Another function of the computer console is self-diagnostics. It performs self tests to the major systems and components in the wheel sensors and the main computer boards. Several diagnostic screens help the service tech zero in on electronic problems quickly. In addition to this, during calibration the computer steps the service tech through the procedure. All calibration adjustments are automatically done in software by the computer.

A computerized wheel aligner in the shop doesn't mean the front and technician never gets his hands dirty. In fact, all the same repairs (and some new ones) still have to be done, and he can do more of them in a day. So the shop can make more money and afford the aligner in the first place. This all has a positive side to it for us poor consumers. We are getting better and quicker alignments and still at a reasonable cost.

Even so, every time I buy a new set of tires I can't help but wonder when the first 'lighter-than-air' Cadillac is going to come off the assembly line. ■

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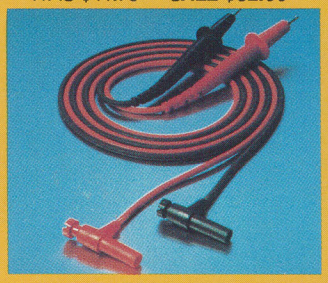

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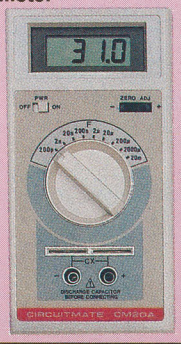

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Advertiser's Index

Microprocessors, Part 5

Continued from page 38

or field of addresses to enable unique devices.

Erasable programmable read only memory (EPROM)
A programmable read-only memory that can be erased and reprogrammed. Most EPROM devices can be erased by exposing them to ultraviolet (UV) light.

Memory map
A drawing or table which shows the address assignments for each device in the system.

Memory mapped I/O
Input/output devices that are accessed using the same group of instructions and control signals as used by the memory devices (RAM and ROM) present in the system. The memory and I/O devices thus share the same address space.

Non-volatile
Property of a memory in which data is not lost when the power supply is removed or disconnected.

Answers to Problems

5.1 (a) 2716 (HN462716, HN462716G)
(b) Hitachi
(c) EPROM
(d) 2K bytes
(e) 2048 words x 8 bits
(f) (i) 24
(ii) 12
(iii) 8
(iv) 19
(v) 21

5.2 (a) 6147 (HM6147, HM6147-3, HM6147P, HM6147P-3)
(b) Hitachi
(c) CMOS static RAM
(d) 4096 words x 1 bit
(e) (i) 18
(ii) 9
(iii) 1
(iv) 12
(v) 8
(vi) 10

5.3. (a) 16K bytes
(b) 32K bytes
(c) 4
(d) 4
(e) (i) RAM
(ii) RAM
(iii) I/O
(iv) nothing (i.e. unpopulated)
(v) ROM ■

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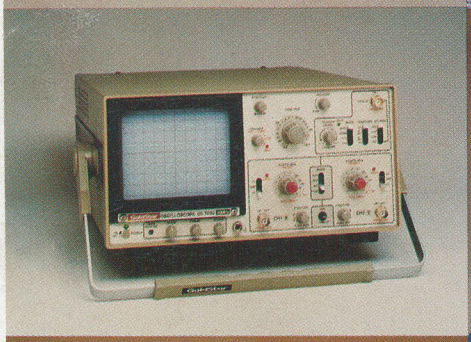

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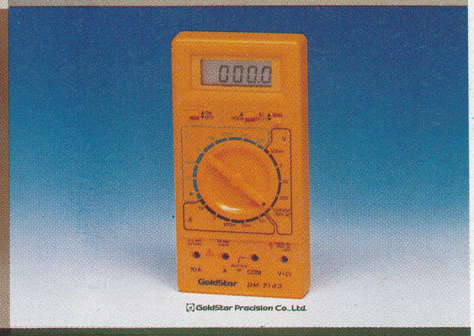

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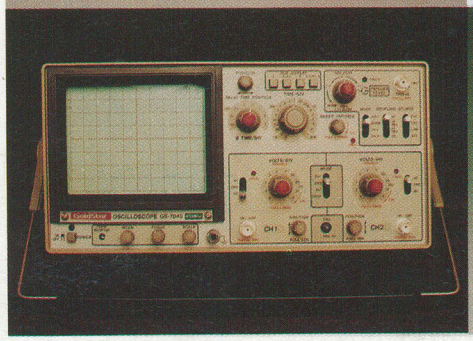

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